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## **Open Science**

### **Open Science Philosophy**

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

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## **Open Science**

### **Open Society**

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

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Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

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or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. These changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

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engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

## **Open innovation**

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

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towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

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Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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# Instruction Program for Human Factors in Maintenance, addressed to The People Working in Colombian Air Force Aeronautical Maintenance Area to Strengthen Operational Safety

Rafael Andres Rincon Barrera

**Abstract**— Safety in global aviation plays a preponderant role in organizations that seek to avoid accidents in an attempt to preserve their most precious assets (the people and the machines). Human factors-based programs have shown to be effective in managing human-generated risks. The importance of training on human factors in maintenance has not been indifferent to the Colombian Air Force (COLAF). This research, which has a mixed quantitative, qualitative and descriptive approach, deals with its absence of structuring an instruction program in Human Factors in Aeronautical Maintenance, which serves as a tool to improve Operational Safety in the military air units of the COLAF. Research shows the trends and evolution of human factors programs in aeronautical maintenance through the analysis of a data matrix with 33 sources taken from different databases that are about the incorporation of these types of programs in the aeronautical industry in the last 20 years; as well as the improvements in the operational safety process that are presented after the implementation of these ones. Likewise, it compiles different normative guides in force from world aeronautical authorities for training in these programs, establishing a matrix of methodologies that may be applicable to develop a training program in human factors in maintenance. Subsequently, it illustrates the design, validation, and development of a human factors knowledge measurement instrument for maintenance at the COLAF that includes topics on Human Factors (HF), Safety Management System (SMS), and aeronautical maintenance regulations at the COLAF. With the information obtained, it performs the statistical analysis showing the aspects of knowledge and strengthening the staff for the preparation of the instruction program. Performing data triangulation based on the applicable methods and the weakest aspects found in the maintenance people shows a variable crossing from color coding, thus indicating the contents according to a training program for human factors in aeronautical maintenance, which are adjusted according to the competencies that are expected to be developed with the staff in a curricular format established by the COLAF. Among the most important findings are the determination that different authors are dealing with human factors in maintenance agrees that there is no standard model for its instruction and implementation, but that it must be adapted to the needs of the organization, that the Safety Culture in the Companies which incorporated programs on human factors in maintenance increased, that from the data obtained with the instrument for knowledge measurement of human factors in maintenance, the level of knowledge is MEDIUM-LOW with a score of 61.79%. And finally that there is an opportunity to improve Operational Safety for

the COLAF through the implementation of the training program of human factors in maintenance for the technicians working in this area.

**Keywords**— colombian air force, human factors, safety culture, safety management system, triangulation

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# Effects of Soil-structure Interaction (SSI) on the Response of Wind Turbines

A. Vatanshenas

**Abstract**—Soil-structure interaction (SSI) effects were investigated on structural responses of wind turbines. Force versus deformation (i.e., p-y curves) was simulated by multilinear elastic springs. The whole system, including the structure, control vibration system and soil nonlinear effects were simulated within a single three-dimensional finite element model. Modeling accuracy was verified using available results related to a 65-kW wind turbine discussed in the literature. Pushover analysis results indicated a fixed base assumption ends up with overestimation of stiffness compared to the case where SSI effects were considered. Moreover, it was observed that the performance of tuned mass damper (TMD) was highly dependent on its tuned frequency domain, and its efficiency decreased significantly after SSI effects were considered. Lateral deformations of a wind turbine were much higher compared to the fixed base condition. Therefore, SSI effects play a crucial part in designing wind turbines and should not be neglected in practice.

**Keywords**—Pushover analysis, p-y curves, SAP2000, Soil-structure interaction, Tuned mass damper, Wind turbine.

# Interactions in aqueous solutions of K-peptide and DMSO – spectroscopic and calorimetric studies

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## **Introduction**

K-peptide (GILQINSRW) – short 9 amino acid fragment of the hen egg white lysozyme has the ability to form amyloid structures. Dimethyl sulfoxide (DMSO) is an osmolyte which can alter this ability. Our goal was to get an insight into the mechanism of K-peptide-DMSO interactions in aqueous solutions. Such a knowledge can be helpful to understand processes leading to various neurodegenerative diseases.

## **Methods**

ATR-FTIR spectroscopy (Thermo Nicolet 8700 equipped with single reflection diamond cell GoldenGate ATR accessory) was used to analyse interactions between solutes in their different proportions: the concentration of DMSO was kept constant in each solution while the peptide concentration varied. In addition, DSC calorimetry (nanoDSC, Thermo) allowed to determine thermal stability of the K-peptide in aqueous solution with or without the addition of DMSO in the wide temperature range: 10-100 °C.

## **Results**

The IR spectrum of the K-peptide exhibited a very strong peak usually attributed to beta-sheets. However, its shape was clearly different than in the case of other native or even denatured proteins. We assumed that it was due to the presence of a specific sheets of amyloid structures. The experimental design allowed to observe changes in relatively sharp peaks on ATR-FTIR spectra attributed to chemical bonds of DMSO caused by the presence of the peptide. These changes turned out to be weak, yet DSC calorimetry allowed to conclude that the K-peptide undergoes a few structural changes during the heating process. Depending on the solution composition and protein concentration, the number and exact temperatures of these transitions varied.

## **Acknowledgements**

This work was funded by the National Science Centre, Poland (grant 2017/26/D/NZ1/00497).

**Keywords**— amyloids, DMSO, DSC calorimetry, FTIR spectroscopy

# Spectroscopic Investigation of Water Structure around Three-Piece K Peptide Fragments

Marcin Stasiulewicz, Sebastian Filipkowski, Aneta Panuszko

**Abstract**— Background: The hallmark of neurodegenerative diseases, including Alzheimer's and Parkinson's diseases, is an aggregation of the abnormal forms of peptides and proteins. Water is essential to functioning biomolecules and it is one of the key factors influencing protein folding and misfolding. However, the hydration studies of proteins are complicated due to the complexity of protein systems. The use of model compounds can facilitate the interpretation of results involving larger systems. Objectives: The goal of the research was to characterize the properties of the hydration water surrounding the two three-residue K peptide fragments INS (Isoleucine - Asparagine - Serine) and NSR (Asparagine - Serine - Arginine). Methods: FTIR spectra of aqueous solutions of the tripeptides were recorded on Nicolet 8700 spectrometer (Thermo Electron Co.) Measurements were carried out at 25°C for varying molality of solute. To remove oscillation couplings from water spectra and, consequently, obtain narrow OD HDO bands, the isotopic dilution method of semi-heavy water in H<sub>2</sub>O was used. The difference spectra method was applied to extract the tripeptide-affected HDO spectrum. Results: The structural and energetic properties of water affected by the tripeptides were compared to the properties of pure water. The shift of the values of the gravity center of bands (related to the mean energy of water hydrogen bonds) towards lower values with respect to the ones corresponding to pure water suggests that the energy of hydrogen bonds between water molecules surrounding tripeptides is higher than in pure water. A comparison of the values of the mean oxygen-oxygen distances in water affected by tripeptides and pure water indicates that water-water hydrogen bonds are shorter in the presence of these tripeptides. The analysis of differences in oxygen-oxygen distance distributions between the tripeptide-affected water and pure water indicates that around the tripeptides the contribution of water molecules with the mean energy of hydrogen bonds decreases, and simultaneously the contribution of strong hydrogen bonds increases. Conclusions: It was found that hydrogen bonds between water molecules the hydration sphere of tripeptides are shorter and stronger than in pure water. It means that in the presence of the tested tripeptides the structure of water is strengthened compared to pure water. Moreover, it has been shown that in the vicinity of the NSR, water forms stronger and shorter hydrogen bonds. Acknowledgments: This work was funded by the National Science Centre, Poland (grant 2017/26/D/NZ1/00497).

**Keywords**— amyloids, K-peptide, hydration, FTIR spectroscopy.

# The Use of Immersive Technology and Building Information Modelling Based Site Safety Management in Construction and Decommissioning of Oil and Gas Facilities

James Cannon

**Abstract**— Continuing development in Immersive Technology (Augmented/Virtual/Mixed Reality) and combined with Building Information Modelling (BIM) offers opportunities to the oil and gas industry to make a step change to the way we manage workforce safety, training and awareness. The aim of this paper will show the potential that BIM and Immersive Technology, could provide for safety in the construction and decommissioning of oil and gas facilities. This research will be undertaken using a systematic review of available studies on the topic of Immersive Technology and BIM in the construction and decommissioning of oil and gas facilities. This approach is adopted because it identifies and appraises the available evidence. The intention is that the search strategy will be comprehensive and reproducible, with all data documented to facilitate validation of the study results. The successful implementation of BIM-based site safety management methods, processes and Immersive Technology can deliver benefits in producing efficient, coordinated designs, allowing clear presentation of complex and challenging construction information to a variety of audiences, while reducing safety risks through inherently safer design and practice. The digitization of information through BIM enables more cohesive collaboration between designers, engineers and the construction team. With all data and documentation available from a central electronic location, all parties can access and discuss the same information. This has the potential to improve the project co-ordination and facilitates early collaboration. In the short term, this means that the oil and gas industry needs to better understand the benefits that can accrue from an effective project common data environment, and how to collaborate to achieve these benefits. In the long run it is important to recognize that technology is maturing, and techniques are improving all the time; and it is anticipated that future work will achieve benefits beyond the ones that are presented here. Efforts should be made to identify and use those technologies that are most effective, in both large and small projects, in capturing and communicating safety and risk information, through design to construction. As construction planning using BIM based site safety management and Immersive Technology matures, the precision of planning should mean that processes and environments are increasingly controlled through early design decisions. This research will envisage a strategy for the practical implementation of technology such as BIM, and Immersive Technology may have the potential to improve safety outcomes at site level during the construction and decommissioning of oil and gas facilities. It will do so by safety training and education, employee site orientation, wearable technology, site-specific safety plans, pre-task planning, job hazard analysis, and monitoring employees' movements on site.

**Keywords**— building information Modelling, immersive technology, safety, training.

# Optical Sound Recognition

Titu Mama, F. Sameer

**Abstract**— We present the beginnings of a new system for optical music recognition (OMR), aimed toward the score images of the International Music Score Library Project (IMSLP). Our system focuses on measures as the basic unit of recognition. We identify candidate composite symbols (chords and beamed groups) using grammatically-formulated top-down model-based methods, while employing template matching to find isolated rigid symbols. We reconcile these overlapping symbols by seeking non-overlapping variants of the composite symbols that best account for the pixel data. We present results on a representative score from the IMSLP.

**Keywords**— optical sound detection, optical sound recognition, sound detection by Image, music.

# Music Note Detection and Dictionary Generation from Music Sheet using Image Processing Techniques

Muhammad Ammar, Talha Ali, Abdul Basit, Bakhtawar, Dr. Zobia Sohail

*Abstract*—Music note detection is an area of study for the past few years and has its own influence in music file generation from sheet music. We proposed a method to detect music notes on sheet music using basic thresholding and blob detection. Subsequently, we created a notes dictionary using a semi-supervised learning approach. After notes detection, for each test image, the new symbols are added to the dictionary. This makes the notes detection semi-automatic. The experiments are done on images from a dataset and also on the captured images. The developed approach showed almost 100% accuracy on the dataset images, whereas varying results have been seen on captured images.

*Keywords*—Music Note, Sheet Music, Optical Music Recognition, Blob Detection, Thresholding, Dictionary Generation

## I. INTRODUCTION

NOTES detection from sheet music is an area of study for the past few years. A lot of work have been done in this area from pre-processing to the detection of complex symbols. We tried to develop an accurate method for notes detection from sheet music using standard image processing techniques. We used some work that had already be done and also developed some new methods.

Optical Music Recognition includes the detection of stave lines and complex music symbols. From the symbol's pixel values its location in staves can also be identified. Once we found the location the pitch of the symbol is detected hence the goal of an Optical Music Recognition is achieved.

After applying the preprocessing on dataset images (noise removal, restoration of rotated image), detection of stave lines, line removal, and detection of symbols has been done. We implemented several methods in this regard, some of them showing good results while others are absolute failures. The details of every failure and success scenario are given in every section of the process.

To start our work needs some images, for that, we used some

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captured images and some images from our selected dataset II. Before object detection, we performed pre-processing (noise removal, inverse rotation) of the images. Rotation is required at pre-processing step because there are chances that the captured image is rotated at some angle. After pre-processing the object detection and dictionary generation is performed.

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## II. DATASET

To implement our work, we need to have some images of the music sheet so that we can check if our algorithm is working fine on it. For that, we are using some captured images and some images from a dataset available online. The dataset we chose for our work is Print Computed Music Image Print (PrIMuS). It contains printed images of music sheets. It only contains one pair of staff lines (a stave). A sample image from our chosen dataset can be seen in the Fig. 1



Fig. 1: An Image from the Dataset

A part from the dataset we also captured some images, to handle the variation in data. The captured images contains some noise in them as well as they are rotated from their original position. The purpose of the captured images is to tackle the case in which the user provides a captured image of the music sheet.

## III. LITERATURE REVIEW

We have classified the research papers we reviewed on the basis of methodology used in them to achieve final goal of the system. The following are the methodologies used:

### A. Neural Network

Optical Music Recognition (OMR) is a challenging task, so its workflow is an extensive task. Given a sequence of music symbols, we can generate the symbol scores with the music engraving software "Lilypond". It shows it with its ground-truth annotations. An OMR approach based on Convolutional Recurring Neural Network (CRNN) is suggested [1]. By doing so is our aim to detect the staves and clefs and complex symbols accurately. But it also entails errors. The most

effective error is of  $S_e$  which is a ratio of scores that are not recognized correctly in their entirety. So, to bring better results we need to diminish this error. For that, a frame-wise transcription using CTC is performed. Moreover, best results are obtained using images of larger size that of 60 by 240 as compared to smaller size images. Importantly, when the network is trained using the CTC loss function, the music symbols do not need to be aligned with the pixels of original images, the way our model is trained, the better it results.

An OMR is created as an object detection function in music images, followed by a classification section [2] that determines the vertical position of each object found within the crew. When clef and other modifications are known, the vertical position of the note adds its pitch. CNN Region-based is used. This system is now known as a network-based convolutional neural network (R-CNN). They used these regional convolutional neural networks based on the OMR region, which are trained indirect detection and classification of musical symbols in a given music document. Musical Object Detection and Position Classification are incorporated in this work. Given the findings and their layout related to the staff queue, the final step is to recreate music semantics and insert the output to the desired format.

A Convolutional Sequence-to-Sequence network is defined [3] as a whole of three elements. First, CNN uploads image upload files in the order of vector presentations. After that, the RNN encoder incorporates a vector sequence of representation of a fixed size, containing all the information from the input points. Finally, the RNN decoder specifies a fixed-size representation for the sequence of output labels. Sliding window installation is used to insert spots from the music page. The following parameters are measured: Pitch accuracy, number of well-predicted packs. Accuracy time, a number of well-predicted note times. Note the accuracy, number of predicted events where both tone and duration are well predicted.

### B. Image Processing

An algorithm RLC to find the thickness of staff lines and the space between the staff lines, any vertical black run that is more than twice the staff line-height is removed from the original [4]. Extensive heuristics and musical rules are applied to reconfirm the recognition. After this operation, the correct detection of key and time signature becomes crucial.

Run-length encoding is used to estimate staff lines [5]. Each run is the number of consecutive pixels of the same value. The peak of the histogram obtained from RLE is a valid staff line. They used Lobb et al. window Fast Fourier Transform method to detect and reverse rotation of the page. Dan et al. developed a method for detecting staff lines called Filtered Hough Transformation. In this method, some filter is applied to the image and then only one staff is detected and others are constructed based on the first detected staff. To detect barlines, a vertical

projection of staff is made. If at a point where there are more than 75% of black pixels, is marked as barline. To evaluate their system they used the Gamera MusicStaves test set. Their algorithm shows more than 90% accuracy.

Practical challenges when someone have to start Music detection is discussed in [6]. Binarization algorithm is explained in pre-processing of image. Binarization algorithm converts the input image into a binary image, having only white or black pixels, where objects like music symbols, staves, etc. are separated from the background. There are two types of binarization approaches. The first are global thresholding methods, which we have to find one particular threshold and apply it to the entire image. The second category is represented by adaptive binarization techniques, which select a threshold for each pixel by information from the local neighborhood (nearby pixels). Music notes can be detected by horizontal projection.

An approach based on the assumption that different OMR systems have different strengths and weaknesses is proposed [7], and that we can determine what they are and use that knowledge to improve recognition levels. The process can be described as follows: points are scaled to a suitable solution, usually 300 dpi, and converted to MusicXML using various OMR programs. Results are standard and are subject to measurement. All types of each measure are compared, and the rules for combining them to minimize errors are applied, depending on the situation. Finally, the optional test category can be used; this may include a personal or automated heuristic look of some kind. The essence of the process is "combining using rules", the error correction section. Three different OMR systems were used in these tests: PhotoScore, SharpEye, and SmartScore. Customization is required because MusicXML supports multiple ways to insert the same content. The standard practice section consists mainly of converting the entire length of time into a normal time and also make default values and place MusicXML items simultaneously as notes in a chord in standard order. The result is missing or additional steps, a big problem because the correct order of steps is important before any kind of comparison can be made. Once the correct correlation coefficient has been obtained, corrective rules should be applied to the case in case of any errors. Errors are defined as any situation where not all programs are compatible." Errors can be corrected in one of several ways.

The first challenge faced by the OMR system in the pursuance of the staff line detection is exposed in [8]. This first task determines the possibility of success for the recognition of music score. And, when it comes to handwritten music scores, existing solutions do not stand up to the mark in the pursuance of satisfactory results. In the following document, a new algorithm for the automatic detection of the staff lines is proposed. The shortest path approach for the detection of staff lines brings out promising results. The technique used is applicable to the wide range of image conditions. In this regard, the intrinsic robustness to partially skewed images is

under work with the promising outputs. The shortest between a starting point on the left margin and an ending point on the right margin at the same row was investigated by them. This will help in coping with severely skewed scores. This task is done using the Dijkstra Algorithm which is well-known for its results in finding the shortest path. To detect the staff lines, the proposed algorithm starts by estimating the start space height. This length will be used as the reference length for the subsequent operations. The shortest path between the leftmost pixel and the rightmost pixel is found using the Dijkstra Algorithm. Next, each retained path is trimmed before and at the end. Next, a comparison is made with each pixel abutting must be black, not other than this and also that it must be in conformity with the shortest path as proposed by Dijkstra Algorithm. With this, we come to the shortest path staff line detection. The results produced with the proposed algorithm is much satisfactory in comparison to the other solution circulating in the market. Staff line detection helps in dealing in many of the challenges to the OMR in the contemporary era, yet it needs a lot of much insight to get it improved and as per the professional standards.

### C. Other Methods

Optical music detection through mobile application is discussed in [9]. A picture is transfer to server from android application, server will process the image, identify note heads, stave lines and clefs. Server will then generate a MIDI file and transfer it back to the mobile application. Image processing is such that image has black background, notes and staves lines are white. Stave lines are detected as if there is sequence of 1...0...1...0...1...0...1...0...1. Also in this paper the flag of notes are ignored.

A scheme that allows for a responsive and efficient interface, which functions with the symbol recognizers implemented in the system is being discussed [10]. Here the human is allowed to interact with all three steps: candidate identification, interactive recognition, and post-processing. In the candidate identification and post-processing steps, the user directs the decision-making process by either selecting a system-proposed candidate, adding a missing candidate, or deleting an incorrectly saved symbol. In Interactive recognition, humans impose extra labeling or model constraints to the recognizer, while the system automatically invokes re-recognition subject in these constraints.

Another paper using Image Processing to detect sheet music by [11]. They used Gamera toolkit in their project. Staff lines are removed as preprocessing and then text and music symbols are separated. When the pitch information and bounding boxes are recognized, the final step is to store the recognized page content in a standard file format. They chose the MEI format. The MEI is an XML-based notation encoding scheme. They developed a web application where user can provide an image and the highlighted staff and notes image is displayed to the user. They used MEI

format document created on the image to display the results.

A novel and effective approach to recognize music scores on mobile devices is discussed [12]. At first, this method deals with music scores captured directly from a mobile camera under the influences of environment acquisition, including distortion, illumination, and different viewpoints. Unlike previous approaches, this system uses some preprocess techniques such as global and local-based binarization and line fitting methods to eliminate the effects of the environment on input images. Moreover, to reduce the complexity, all symbols are grouped into ten main classes that have similar features before applying SVM to recognize each symbol in these main classes. In summary, contributions involved are: Our approach is applied global and local threshold-based binarization and line fitting method to remove illumination effect, distortion, and noise from input music scores to improve the performance of the system. Heuristic characteristics are used to classify all symbols into ten subclasses with similar features reduced the number of classes and the difficulty level for SVMs. The rest of the paper deals with the works about recognizing the music score recognition systems.

The visual music recognition system has been completely redesigned and rearranged by a new framework called the Gamera [13]. The new open-source software is not only designed to find a variety of music tracks, including handwritten notes but can also be used to create programs that can see many other structured texts. The camera is intended to be used by local experts with specific knowledge of the literature to be known but without strong creative skills. Gamera contains processing and recognition tools in an easy-to-use, interactive, writing environment. Additionally, the program can be extended with C ++ and Python plugins.

## IV. METHODOLOGIES

### A. Pre-Processing

When an image is passed to the system there are chances that the image is rotated, colored or having noise. For the image to be pass through the whole process, it is necessary for it to be perfect. In the pre-processing part, we make image to be notes detectable. The pre-processing includes:

1) *Thresholding*: Thresholding is a simple but effective tool to separate objects from the background and has been a technique used for the segmenting light and dark regions. The grey level image is converted into binary images by changing all of the pixels below a certain threshold value (T) to 'ZERO' and all above that threshold value to 'ONE'. We assumed that the input image is in grayscale therefore for the colored image is converted to the grayscale before further processing.

In Simple Thresholding, a global value of threshold was used which remained fixed all over the image. Resultantly, a fixed threshold value would not serve in the case of variable lighting conditions in various areas. Adaptive thresholding is the method where the threshold value is computed for

smaller regions. This leads to different threshold values for different regions with respect to the change in lighting. Given in Fig. 2 are the results of local thresholding of the captured images which computed threshold value for each specific region and consequently led to the required output and implied a satisfactory result for further processing.

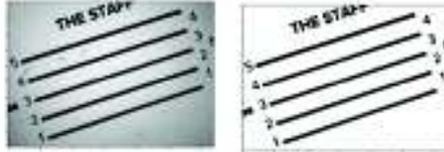


Fig. 2: Local Thresholding of the Image

2) *Rotation*: For an input images, there are clear chances that the captured image is rotated at some angle. To find the angle at which the image is rotated we have to find the staff lines as the coordinates of the lines helps to find the angle. The details that how we find the staff lines is given in Section IV-B of the paper. When we find a line, we compare the x and y coordinates of two points on that line. We have to find 2 points A and B on the lines like illustrated in the image below. The perpendicular and base of those points can be drawn by projections and from those rectangular coordinates angle at which the line is deviated is also calculated. We can also find if the image is rotated clockwise or counter clockwise by just comparing the y coordinates of points A and B.

When we have found the angle at which the image deviates, next step is to restore the image to its original position which is rotating it back to normal. For this we consider the points of the image as it is rotated at some angle at some pivot point. If the image is rotated clockwise the pivot point will be the top-left pixel of the image and if the image is rotated counter-clockwise the pivot point will be the bottom left pixel of the image. For every point, we have x and y coordinates and a pivot point. Considering the pivot point as the center of a circle, we calculated the radius r of that point from the pivot. We already know the angle at which it is deviated so the point after rotating back is calculated with:

$$\begin{aligned}x &= r \cdot \cos(\theta) \\y &= r \cdot \sin(\theta)\end{aligned}$$

We found the expected result from this method. Considering A as our pivot (which is clearly not in a real scenario) point, the point to find is at D which can be found by considering A as the center of the circle, distance from A to be as radius r and we already know the angle. The curve in blue is actually the projection of point B towards D. The scenario is illustrated in the Fig. 3.

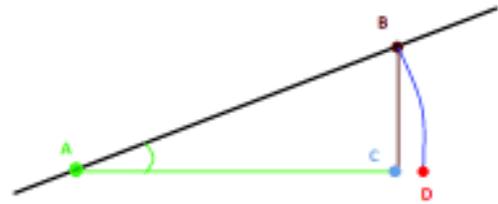


Fig. 3: Rotation Illustration

3) *Noise Removal*: The thresholding of the image cannot guarantee noise removal. As most of the noise is removed by adaptive thresholding of the image but still there are chances that there are some unexpected black or white pixels. The image rotation also results in creating some noise. We can call this type of noise salt and pepper noise. To remove this noise we used a median filter. In the median filter, we arrange nearby pixels of a pixel whose value is going to affect, in ascending order and then replace that pixel value with the median of the nearby pixel values. This method results in reducing the noise, which ultimately helps in achieving the goal.

### B. Lines Detection

After pre-processing, the images are almost perfect. The lines are no more rotated and there is almost no noise in it. Now we are moving towards the first step in the detection of OMR, which is line detection. There are several methods for line detection and there is a lot of work done in this regard. For lines detection, we start from the bottom left corner of the image and moves towards the right. In each column, we were looking for the first five lines in that column whose pixel values in a sequence of 0...1...0...1...0...1...0...1...0... Here 0 indicates black pixel which is part of staff line and 1 indicates white pixel which is part of space between the lines. After this, we achieved the first pair of lines and their location. When the first pair is detected we start looking for the next pair above the detected pair so that the same pair is not detected every time and keep on doing so until no pair is found. Now we have an array of arrays storing the start of staff lines and space lines in them. While doing so we had tackled several problems. Even after removing the noise, the lines detection was not an easy task. We did one traverse from left to right but there was a problem with it. When a first pair is found we start looking for the next pair from above of the found pair and move one pixel towards the right (x-axis). The problem there was that a pair can be found moving a lot of pixels towards the right but there are chances that the above pair cannot be found toward the right of that pair it can be towards the left. That's why we place the x coordinate again to 0 and starts looking for the sequence. We got the desired results in the line detection part of the job.

### C. Lines Removal

We used the coordinates received from the line detection part of the system to remove the lines. Line removal is necessary for our system as the notes detection cannot be

done without line removal. For detection of notes, it is necessary for our system to have an image that contains only notes and there should be no black pixel in the background. To remove staff lines, we check some percentage of the thickness of the line above and below the line. If we found notes in that range, we decide whether we have to remove the line or not accordingly. As we know the starting and ending points of each and every staff line so we decided to remove that line horizontally keeping in mind the notes. If there is a notehead on the line, we did not remove that part of the line otherwise we remove that part of the line. The results we got are quite interesting. It works fine on the images from the dataset but when we apply it on the captured images, the results are not perfect. The results of the dataset images after line removal is shown in the Fig. 4.



Fig. 4: Staff Lines Removal

#### D. Object Detection

In this section, we aimed to detect different music symbols from the images in which lines have been removed. In first attempt we tried to design an algorithm which manually iterate through pixel values of image to get object properties and it gave starting and ending points of notehead. We found thickness and height of noteheads by this method but this method has its limitations as we would have to write tons of code to accomplish our goal. So we changed our approach and moved towards using some methods in python libraries. One of the methods that we used to get some properties of objects in a binary music sheet was using labelling method. In the first step we find threshold of our input image. After finding threshold, we used it to produced our labelled image of the sheet. In the next step, we calculated some useful properties of our objects that can be utilized in future, when we will work on object classification in detail. Some of these properties were, centroid coordinates, bounding box coordinates and area of individual objects etc.

In the final part of this section, we classified the objects by matching them by a template object. We calculated coordinates of the object in the music sheet containing maximum probability of matching with our template. Probability image is shown in the Fig. 5:



Fig. 5: Generated Probability Image

As we can see the darkest point is where value is minimum and probability is highest. Using above probability image, we detected the object in original image and

created bounding box around it to show the result. The resultant image after this process is shown in the Fig. 6:



Fig. 6: Detected Objects using Probability Image

By using above method, we could only detect one symbol that matched perfectly with our template. But we wanted the detection to be flexible and it should detect all symbols that were matched to a satisfactory level, not just one. So we changed the method which allowed the detection to be as flexible as we wanted. We picked a threshold and every object which was similar to our template was picked by our function. The result of using '0.81' as threshold value is shown in the Fig. 7:



Fig. 7: Detected objects after applying threshold

#### E. Dictionary Making

In the process of dictionary-making, we decided to extract unique objects from our dataset. Initially, the dictionary was empty and as we iterated through images from our dataset, this section of the model extracted unique objects from the images automatically. Whenever an object is detected in an image, it is first checked in the dictionary. If it is already in the dictionary system does nothing and if it is not in the dictionary then it is added to the dictionary.

### V. EXPERIMENTAL EVALUATION

While thresholding image, we first used OTSU method. The results from this method is not upto the marks, there are still some black pixels in the background after applying OTSU method, as shown in the Fig. 8.

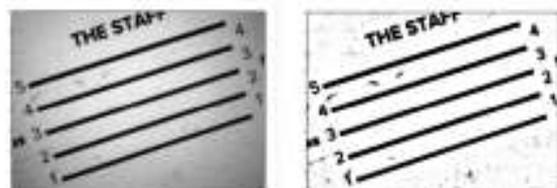


Fig. 8: Thresholding with OTSU Method

The OTSU thresholding technique seems to be not working for our system then we go for adaptive thresholding. Adaptive thresholding is the local thresholding of the image.

To restore a rotated image back to its position we find the angle at which the image is rotated. When the angle is known, it is time to restore back it to its original position.

For this, we first used Pythagoras theorem to find the perpendicular of each pixel and then move that pixel to perpendicular points above or below (depending upon the direction of rotation) its original location. We did not get the expected results as the image is rotated, which can be handled by considering it to be rotated at some pivot point and considering the points as circular coordinates.

We used the coordinates received from the line detection part of the system to remove the lines. We tried to remove lines by at least 2 or 3 methods. At first, we tried to remove them by the coordinates we received from the line detection part. We have the starting and ending point of each staff line and we check if there are black pixels above and below that point. If there are, it means that there is a note on that line. In this case, we did not remove that part of the line. If there is no black pixel above or below that line, we removed that part of the line. Then we check if there are black pixels above but not below or vice versa then it means that the note is in the space so we also remove that part of the line. We did it on both the captured images and the images from the dataset. The results are shown in Fig. 9 and Fig. 10.



Fig. 9: Lines Removal on a Dataset Image

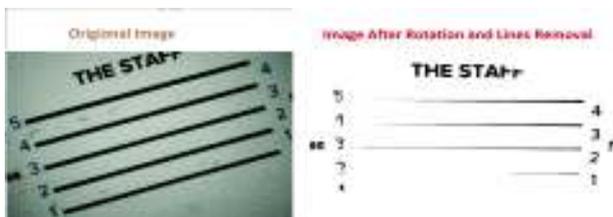


Fig. 10: Lines Removal on an Captured Image

Then we used the method explained in the methodologies part IV of the paper. That method produced satisfactory results.

## VI. COMPARATIVE STUDY

A human interactive system is being developed chen2016human which allowed the user to add missing symbols and removed incorrectly detected symbol. While in our system we used a semi-supervised approach to detect symbols in the music sheet. We created a dictionary of symbols and check if the symbol detected on the sheet already exists. If not then the symbol is added to the dictionary as well.

Some of the authors used images from a dataset ([5], [5], [11]) and some used captured images ([9], [1], [12]). While we used both captured and images from a dataset.

The work of Dai[9] is showing about 80% of accuracy, while the system developed by Ringwalt [5] is about 98%

accurate. The reason is that there is no or relatively less noise in images from a dataset so the symbols can easily be detected. Our system is showing almost 100% accuracy on the images from the dataset (assuming that the images contains noise and pre-rotation) for evaluating the performance of our proposed method.

## VII. FUTURE GOALS

In future, we intend to work on optical music recognition in more depth. We will explore new methods to accomplish our goals and also improve the work we have done so far. We also intend to make an application that will detect music symbols from input music sheet and will calculate their positions according to staff lines and generate a human understandable file that will explain the information in that music sheet.

## VIII. CONCLUSION

In this work, we have built a system that detects music symbols from music sheets and is able to generate a music symbol dictionary from that dataset automatically. Firstly this model takes an image and preprocesses it to remove any blur, rotation, noise, or anything that can affect the efficiency of the system. Then the lines are removed to detect individual symbols and several techniques such as blob detection and template matching are used to extract symbols from the image and then compared to our dictionary. If any symbol does not appear in our dictionary, it is added to it as a new symbol.

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# Multi-instant Finger Vein based Biometric System Framework

Tomas Trainys, Algimantas Venčkauskas

**Abstract**— Application of biometric features to the cryptography for human identification and authentication and data encryption is widely studied, and promising area of the development of high-reliability cryptosystems. Biometric cryptosystems typically are designed for pattern recognition, which allows biometric data acquisition from an individual, extracts feature sets, compares the feature set against the set stored in the vault and gives a result of the comparison. Preprocessing and feature extraction of biometric data are the most important phases in generating a feature vector for key generation or authentication. Fusion of biometric features is critical for achieving a higher level of security and prevents possible spoofing attacks. The paper focuses on the tasks of initial processing and fusion of multiple representations of finger vein modality patterns. These tasks are solved by applying computer vision methods for image preprocessing and feature description. The article presents a framework for generating sets of biometric features from a finger vein network using several instances of the same modality. The proposed framework was tested and compared with the performance and accuracy results of other authors.

**Keywords**—Bio-cryptography, biometrics, cryptographic key generation, information security, pattern recognition, finger vein method.

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# Congestion Analysis of Patient Flow in an Emergency Department on the Post-Earthquake

You-Xuan Lin, Chi-Hao Lin

**Abstract**—After a violent earthquake, the supply of medical services may fall short of the rising demand, leading to congestion in an Emergency Department (ED). This paper aims to discuss the influences of the earthquake-induced casualties with low acuities on the performance of an ED, in terms of (1) patient sojourn time, i.e., the period from arrival to exit, and (2) recovery time of an ED. In 2018, a 6.2 magnitude earthquake shook Hualien, the eastern coast of Taiwan. A local hospital reported that an influx of patients with minor to moderate injuries congested the ED. Moreover, according to the official after-event summary report, over 90% of casualties fall in the categories of minor/moderate levels. All indicate that a sudden increase of earthquake-induced patients with slighter injuries is a vital problem to be tackled. In this study, we used Discrete Event Simulation to delineate the state of an ED confronted with surging patient arrivals after massive earthquakes (over PGA 0.47g). Patients in our simulation were generated at the rates postulated in the context of Chile. The patient arrival rates across four days under the normal condition and different seismic scenarios are presented. Preliminary results show that when the sum of patients is increased by 1.4 times and causes an increase in sojourn time by maximally 4 times, the queuing pattern still can return to the normal state right after the earthquake-related patient arrivals terminated (the 5th day following the earthquake in our simulation). However, if 2.3 times more patients flood in, the sojourn time would be maximally 36 time longer than usual. As compared with the previous case, the recovery would take 6 more days to complete.

**Keywords**—congestion, emergency department, patient flow, post-earthquake.

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# Efficient Ammonia Removal from Waste Water Using Selected Cathodes and MnO<sub>2</sub>/Graphite Anode: Experimental Study and Mechanism Verification

Marzieh Joda, Narges Fallah, Neda Afsham

**Abstract**— Selected cathodes, including plates of titanium (Ti), iron (Fe), copper (Cu) and aluminum (Al), combined with a MnO<sub>2</sub>/graphite anode (a manganese dioxide electrodeposited on graphite) were employed for studying quick ammonia removal from ammonia wastewater in this work. Cathode materials, current densities and the presence of chloride ions (Cl<sup>-</sup>) in ammonia wastewater were investigated as to the effects on ammonia removal. Ammonia and two main reduction products, i.e. nitrite and nitrate, were measured using ion chromatography. The results showed that the ammonia removal efficiency decreased in the order of cathode materials: Ti>Fe > Cu > Al. The optimum removal was achieved to be more than 50 % for a concentrated ammonia solution (500 mg/L ammonia) solution by using titanium cathode and MnO<sub>2</sub>/graphite anode after 120-min electrolysis with a current density of 30 mA/cm<sup>2</sup>. The subsequent experimental results showed that the current density of 15 mA/cm<sup>2</sup> is also high enough for achieving a considerable ammonia MnO<sub>2</sub>/graphite removal. Moreover, the presence of Cl<sup>-</sup> in water was proven to have a significant effect on concentrated ammonia removal and also be able to promote the destruction of nitrite and nitrate ions, resulting in the virtual decrease in ammonia. By a designed experiment, the ammonia removal pathway was confirmed to include a reciprocating reduction (of ammonia) and oxidation (of nitrite and nitrate), both of which can lead to the removal of ammonia by the generation of nitrogen in direct and indirect electro-oxidation because of morphology MnO<sub>2</sub> and presence of Cl<sup>-</sup>.

**Keywords**— ammonia removal, cathode material, manganese dioxide, mechanism.

# A Dynamic Rhizosphere Interplay between Tree Roots and Soil Bacteria under Drought Stress

Yaara Oppenheimer-Shaanan, Gilad Jakoby, Maya Starr, Romiel Karliner, Gal Eilon, Maxim Itkin, Sergey Malitsky, Tamir Klein

**Abstract**— Root exudates are thought to play an important role in plant-microbial interactions. In return for nutrition, soil bacteria can increase the bioavailability of soil minerals. However, root exudates typically decrease in situations such as drought, calling into question the efficacy of bacteria-dependent mineral uptake in such stress. Here we tested the hypothesis of continued exudate-driven microbial priming on Cupressus saplings grown in forest soil in custom-made rhizotron boxes. A 1-month imposed drought and concomitant inoculations with *Bacillus subtilis* and *Pseudomonas stutzeri*, bacteria species isolated from the forest soil, were applied using factorial design. Direct bacteria counts and visualization by confocal microscopy showed that both bacteria become associated with Cupressus roots. Interestingly, root exudation rates increased under drought. Over 100 metabolites were identified in exudates, including phenolic acid compounds and organic acids that were shown to be used as carbon and nitrogen sources by both bacterial species. Importantly, soil phosphorous bioavailability was maintained only in inoculated trees, mitigating drought-induced decrease in leaf phosphorus and iron. Our observations of increased root exudation rate when drought and inoculation regimes were combined support the idea of root recruitment of beneficial bacteria. Hence, the improved mineral nutrition provided by priming apparently offsets the host loss of carbon and nitrogen even under adverse conditions.

**Keywords**— metabolomics, microbial priming, root exudation, root-bacteria rhizosphere interactions under drought, trees forest.

# The Impact of *Pseudomonas Qingdaonensis* ZCR6 Strain and Meat-Bone Meal on the Effectiveness of Phytoremediation Process

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**Abstract**—Environmental pollution is one of the greatest problems that the world is facing today. Co-contamination of soil with hydrocarbons and heavy metals has become a major problem of human health and global environment. The aim of the study was to evaluate the phytoremediation efficiency of soil co-contaminated with hydrocarbons and heavy metals using *Zea mays* supported with plant growth-promoting *Pseudomonas qingdaonensis* ZCR6 strain and by the addition of meat-bone meal (MBM). The hydrocarbon and heavy-metal contaminated soil was obtained from an industrial area in the vicinity of the Coke Plant in Zabrze (Upper Silesia, Southern Poland). The phytoremediation experiment was carried under laboratory condition and had six treatments: (1) planted soil inoculated with live ZCR6 strain (live bacteria, LB), (2) planted soil inoculated with thermal inactivated ZCR6 strain (thermal inactivated bacteria, TIB), (3) planted soil treated with water (water, W), (4) planted soil treated with MBM and inoculated with live ZCR6 strain (LB+MBM), (5) planted soil treated with MBM and inoculated with thermal inactivated ZCR6 strain (TIB+MBM), (6) planted soil treated with MBM and water (W+MBM). The total petroleum hydrocarbon concentration in soil was quantified before and after bioremediation study as Thehydrocarbons with carbon number between 10 and 40 (TPH<sub>C10-40</sub>) following ISO 16703:2011 standard. The total heavy metal concentration was evaluated using an atomic absorption spectrophotometer before and after phytoremediation experiment. During the experiment the bacterial survival in soil, as well as ability to colonize tissues of *Zea mays* was monitored. It has been observed that 15 days after bacterial inoculation all plants from soils treated with MBM (LB+MBM, TIB+MBM, W+MBM) died. Despite this the experiment was continued until day 40. It has been estimated a significantly greater effectiveness of TPH removal in all soils treated with MBM (LB+MBM, TIB+MBM and W+MBM) compared to soils non-treated with MBM. The average level of TPH loss in soils treated with MBM reached value of 32% of the initial hydrocarbon concentration. Among the soils non-treated with MBM significantly higher TPH removal was observed in soil TIB, compared to soils LB and W. In the case of heavy metal loss, no significant differences in the efficiency of Cd, Zn and Cu removal were observed between analyzed treatments however, for all metals the highest removal efficiency was estimated for soil LB. *Pseudomonas qingdaonensis* ZCR6 had ability to survive in both soil treated and non-treated with MBM during the whole experimental period. It had also ability to colonize tissues of *Zea mays*. This preliminary study suggests that the microbial-assisted phytoremediation of soil co-contaminated with hydrocarbons and heavy metals, using *Z. mays* and plant growth promoting ZCR6 strain, is a promising technology. However, it has been noticed that addition of MBM into co-contaminated soil had a negative impact on the growth of *Zea mays*. On the other hand, addition of MBM had a positive impact on the removal of hydrocarbons from soil. The research was supported by grant No. 2018/31/D/NZ9/01610 financed by the National Science Centre (Poland).

**Keywords**— Phytoremediation, hydrocarbons, heavy metals, *Zea mays*, *Pseudomonas qingdaonensis*.

# Impact of Brand Experience on Brand Engagement with the Mediating Role of Brand Lovey

Jamshid Salar, Morteza Asghari Valik Chali

**Abstract**— The purpose of this study is to investigate the impact of brand experience on brand engagement with the mediating role of brand love. This study, in terms of purpose, was applied and in terms of data collection, was descriptive (survey) type. The statistical population of this study included customers of Bank Melli Iran branches in Sari city. The sample size was selected based on the available non-random sampling method and the formula of Cochran with sample size (384 people). The data collection method was library and field type. In the field method, we used the standard questionnaire. To evaluate the validity while using content validity, structural validity (convergent, divergent validity, and composite reliability) was also used. The reliability of the questionnaires was also assessed by Cronbach's alpha test. The results of convergent, divergent, and composite reliability studies showed a good fit of measurement models, and also, the results of Cronbach's alpha study showed good reliability of each variable. After ensuring the validity and reliability of the research questionnaire, the final data collection was performed, and the results were analyzed using structural equation modeling under partial least squares (PLS). Finally, the results showed that the brand experience, both directly and indirectly, mediated by brand love, has a positive effect on brand engagement.

**Keywords**— brand experience, brand engagement, brand love, brand.

# Effects of Metal-Semiconductor Interface in the Photocatalytic Activity of Ag/ZnO Hybrid Nanostructure

A. Ziashahabi, R. Poursalehi, S. Kadkhodazadeh

**Abstract**— Plasmonic nanomaterials can substantially enhance visible light absorption of large band gap semiconductors and have shown great prospects in solar energy harvesting and conversion. To achieve maximum solar energy utilization, rational design and synthesis of plasmonic nanostructures are essential. In the present research, a new synergetic hybrid Ag/ZnO nanostructure was fabricated. ZnO was prepared with the liquid arc discharge technique and Ag was synthesized and deposited on the surface of ZnO with chemical reduction method. The Ag nanoparticles are expected to act as photosensitizer of ZnO and increase the photocatalytic efficiency compared to pure ZnO nanostructures. The hybrid nanostructure, degraded methylene blue in high yields under visible light illumination and in dark. In this framework, the metal-semiconductor interface has a significant effect on the charge transport properties of this hybrid photocatalyst system. Silver oxidation changed the interface properties and suppressed the photocatalytic degradation in the hybrid Ag/ZnO nanostructure. The results of photoluminescence (PL) and X-ray photoelectron spectroscopy (XPS) revealed that there are oxygen defects in the ZnO nanostructures. The XPS O 1s peak composed of two components at 530.6 and 532.6 eV, which corresponds to lattice and surface adsorbed oxygen species, respectively. The PL analysis showed an intense peak in the UV and several peaks with lower intensities in the visible region of the spectrum. The UV peak appears in the spectrum due to near band edge emissions and visible peaks are ascribed to defects and oxygen vacancies in the ZnO nanostructure. In this hybrid plasmonic nanostructure, plasmon-assisted hot electron injection from Ag to ZnO leads to a high visible light absorption and enhanced the photocatalytic activity. Moreover, oxygen defects of ZnO may acts as electron traps and inhibit charge carrier recombination resulting in photocatalytic enhancement. These results illustrates how oxidation affects the photocatalytic performance in hybrid plasmonic nanostructures.

**Keywords**— Ag/ZnO hybrid nanostructures, dye degradation, metal-semiconductor interface, plasmonic photocatalyst

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# Effective Policies to Improve the Cyber Security-Privacy of Smart Cities

Mehdi Niazi, Nasim Piran Nanekaran

**Abstract**—Smart cities consist of different sensors and smart mobile and fixed equipment that exchange data between various devices and users through the Internet of Things (IoT) technology using intelligent algorithms. Here, there is some vital and critical information, the protection of which foregrounds the significance of security and privacy issues in smart cities. Hence, the paper stated the key potential threats and the solutions associated with cybersecurity and privacy regardless of various architectures and levels, along with the proposed Enabler policies. The mentioned solutions are the product of the practical and scientific experiences of the authors, which have been collected through field and library studies.

**Keywords**— Cyber threats, internet of Things (IoT), privacy, security policies, smart cities.

## I. INTRODUCTION

With the emergence of complex problem and risks in the fields of administration, education, traffic, energy, pollution, planning, and many other fields in the electronic world, equipping cities with sensors and intelligent monitoring and control tools through IoT and the development of smart cities is expected to be a good way to increase efficiency, speed, accuracy and improve the life quality in smart cities [1]–[2].

Smart cities are composed of the connection of different physical-cyber components in common infrastructures and independent systems, with heterogeneous and interconnected communication platforms like sensors, computing elements, network objects, and so on interacting through the IoT. Hence, IoT is an information capability added to major urban infrastructures like vehicles, hospitals, training centers, organizations, and buildings to facilitate urban management [3].

Smart urban management is used in many fields like healthcare, transportation, entertainment, public safety, smart agriculture, power grids, and smart buildings [4]–[5]. When it is talked about smart cities, it is mainly talked about communication protocols and equipment, artificial intelligence algorithms, and sensor networks. A sensor network is composed of a set of sensors or interconnected nodes with various purposes and functions to measure the values of certain physical parameters like temperature, vibration, humidity, and so on [6].

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Then these values are assessed by artificial intelligence algorithms and the results or data are transmitted as data or control information by suitable communication equipment. Among these, some applications like military surveillance and control, health care of individuals, or financial information of companies and individuals contain very important and vital information [7]–[8], especially the applications used online. Moreover, this information is threatened by “bots”, viruses, and any malicious code (9, 10). Hence, the most important concerns of societies about the acceptance and implementation of smart cities are issues related to privacy, data accuracy, and security against cyber-attacks or unauthorized access.

Although this has been explored in different aspects over the years [7]–[11]–[12]–[13], there is still no framework for security policies to guarantee the privacy and information security of smart city users. The paper tries to state effective policies in this regard. It has to be noted that obtaining an excellent degree in this field is so hard and calls for continuous and extensive efforts, and thus a compromise must be made in the supply of technologies and protection of privacy [14]. The rest of the paper is as follows. Section 2 describes the most important threats, attacks, and ways to limit or counter them. Section 3 is the presented effective policies in security design and the discussion of the privacy of smart cities and finally, Section 4 presents the summary and conclusion.

## II. Cyber-Attacks On Smart Cities And Ways To Prevent Them

A cyber-attack is any form of attack where a person or an organization targets computer information systems, infrastructure, computer networks, or personal devices by exploiting security holes. These attacks include different types like stealing, altering, or destroying data and information systems [15]. Among the signs of an attack are the following:

If you figure out that some of your specific programs are not functioning, some files have been deleted from your system without your permission, passwords have changed, and some of your computer information is online (usually the Internet) when you did not allow such a thing, you will see programs in your system that you have not installed yourself, while you are doing something else your computer is constantly trying to connect to the network and eventually slows down the upload and download speeds

Here, some common cyber-attacks along with effective ways to prevent them are explained.

- DoS and DDoS attacks

A type of attack, which stands for Denial of Service (DoS) and affects both the network and application layers, can lead to the unavailability of the service to users. In other words, DoS attacks disrupt the network by creating unexpected traffic to the site and sending disruptive information and cutting off user access. This type of attack in smart cities can threaten the management and control of the city [16]. Distributed DoS (DDoS) attack means that a large number of requests (Request) flow to a server (victim or target computer) and overuse of resources (processor, database, bandwidth, memory, and so on) so that the normal service is disrupted or made inaccessible to its users. The difference between the two is that in a DoS attack, a server crashes with a large volume of UDP and TCP packets sent from one computer crashes; however, in DDoS, several devices work together to target a victim and bombard it with packets from various locations and IPs. In larger attacks, large networks of computers and Internet-connected devices - sometimes numbering in the millions - are captured by malware and used by hackers. These devices are called Botnets (Robot Network) or Zombie Network. In a DDoS attack, as every bot is using the Internet normally and legally, it is very difficult to separate the actual site traffic from the traffic generated during the attack. Many HTTP Requests are sent to the server, the server overflows and DDoS occurs. Another type of DDoS attack is Protocol Attacks that use vulnerabilities in OSI Layers 3 and 4 (Transport and Network) to make the target inaccessible. Protocol attacks are done for exhausting the server and over-consuming its resources. During this type of attack, firewalls or load balancers become severely disrupted and service disrupted. SYN flood attack is an example of a protocol attack [17]. Volumetric attacks are another type of DDoS attack that intends to make the most of the available bandwidth. Thus, a very large amount of data is sent to the target using an amplifier that generates a lot of traffic (like the botnet we already earlier) and starts to use its bandwidth. For instance, a DNS Amplification attack is an example of a volumetric attack. Dealing with DDoS attacks has relatively simple solutions, some of which will be stated here. First, using monitoring tools, site traffic should be constantly monitored and abnormal activities detected by understanding its patterns and features. Second, security infrastructure and obsolete systems and software, firewalls, security applications, and web applications have to be upgraded. If possible, the hosting company should be asked to enable it if it has a specific security layer to reduce the possibility of vulnerable connections. Third, the cloud infrastructure is used. The cloud server provides you with more resources, it can be upgraded very quickly and easily, and as it uses clustered servers instead of relying on a specific server, because if you are the target of a DDoS attack, the traffic on different servers is distributed to one server will not be pressured and your site will not be easily accessible. Fourth, use a content delivery network (CDN). CDN is a network of servers deployed around the world, storing a copy of the site's content and delivering it to users from the nearest point of view. Therefore, when a DDoS attack takes place and you are using a CDN, other network servers that are still active can take over

that server and respond to user requests if a server becomes inaccessible [18]–[19].

- Malware

Malware is code secretly hidden by a hacker in personal and organizational systems to let him reach his target. There are several types of malware, including spyware and ransomware. Using such software in the worst possible way can endanger the privacy and security of the people and the government. This is because malware can access the city and even home cameras, or the numbers that people enter on sites and applications without their permission. These toxic codes can disrupt a network completely and reduce the performance of a machine to zero. The most famous type of these attacks is Trojan horses. Trojan horses are usually in the form of efficient software, encouraging the victim to install and use them. This type of attack is one of the most dangerous of all malware and cyber-attacks and usually targets financial information. Overall, through Malware, it carried out all kinds of malicious acts like the destruction of physical execution, theft, altering and copying of information, and even eavesdropping on people's work and living environments (by the camera) with the intent of spying, abuse, theft and any other malicious intent [20]. Encryption and compression can be used to cope with malware. Block chain technology can be dramatically effective [15] – [18]–[21]–[22]–[23]. Moreover, good results have been reported in the case of ECC encryption or Elliptic Curve Cryptography [24]–[25]–[26].

- Eavesdropping Attacks

This type of attack is done by intercepting traffic exchanged on the Internet and intends to steal information sent and received by smartphones or computers. In some cases, the purpose is other than listening to data or information and can be used to analyze in various situations to capture the behavior and pattern of network traffic and network map. Therefore, eavesdropping itself may be a prelude to other attacks compromising system confidentiality. Eavesdropping is of the attacks difficult to detect because of unchanged data or information. The ideal target for hackers to plan this type of attack is weak networks that transfer information between the user and the server without / or with weak security policies and provide a good opportunity for them to infiltrate. This attack in smart cities is a major threat to the trust and confidentiality of the information and can lead to financial, personal, or organizational failures [27]. Appropriate eavesdropping solutions have been suggested based on advanced encryption at the application layer, transport layer, and dynamic change of encryption algorithms, and policies that send packets across multiple untraceable paths [28].

- Spoofing Attack

Faking identity means a user's unauthorized access to information or a device by manipulating another user's identity information. This attack is realized by different approaches like email forgery, GPS forgery, Referrer Spoofing, location forgery, IP address forgery, file sharing forgery, file transfer

forgery, TCP forgery, DNS forgery, and some other protocols. This can jeopardize the information integrity and security of the smart city [29].

- Injecting Incorrect or Useless Messages

Dissemination of incorrect information, intentionally or unintentionally, can have a negative effect on the behavior of the system and other components of smart cities, as the individuals and devices in the smart city make decisions and actions based on data and information [15]. Thus, in the most optimistic case, it can cause network traffic, increase the load and disable some services in the smart city. A similar type of attack is the “Message Change Attack.” Changing the order in which messages reach individuals or devices can have negative effects like delays or congestion, threatening system integrity too.

- Phishing Attacks

These attacks usually happen in online stores and during online payments. Thus, the user is directed to the banking portal after selecting the product, which may be made by a hacker, the user is redirected to a fake address that looks exactly like the site of the relevant bank and thus provides his bank card information to the hacker. Phishing is a type of social engineering-based attack where an attacker deceives a target or targets to obtain sensitive information like passwords, credit card details, and so on [30]. Phishing attacks are conducted differently like deceptive emails, telephone phishing, page design like bank payment gateways, and using fake POS machines and ATMs. Given the electronic nature of smart cities, phishing attacks are more likely to occur in the future than other cyber-attacks and malware causing more harm to users by stealing large amounts of personal and identity information about people and objects. Statistics confirm this too, as the FBI has stated that phishing complaints have increased more than 11 times in 2020 compared to 2016 and that most attacks have been carried out via email [31]-[32]. Thus, more attention has to be paid to this issue. To prevent phishing attacks, it is better to pay attention to the URL when paying online and buy only through valid URLs. The financial and banking system never asks the user to send them banking information via email. Moreover, it is better to state that the deposit of any amount into the account of the winners, including prizes, rewards, and benefits, does not need to reveal a bank password to prevent telephone phishing [33].

- Ransomware

This is software that infiltrates the systems of individuals, corporate, and government companies and restricts access to systems or files like financial information. The ransomware maker then demands ransom from the system and data owners to remove the restriction, and the victim's information may be deleted if the hacker or ransomware maker, who usually pays, is not granted. The method of restricting access to the system or information by ransomware is usually done by encrypting or locking files and data [34]. There are some reports that police computer systems have lost digital evidence through ransomware and in some cases have been forced to pay [35].

Additionally, ransomware attacks on urban infrastructure like transportation, energy supply, payment systems, and health have been reported too [36]. Hence, ransomware can result in any misuse, including fraud, illegal exploitation, destruction, and delays in smart city services.

- Man in the Middle (MITM)

In a MITM attack, a hacker gets in the middle of two-way communication and steals the information they exchange anonymously without the parties knowing. Indeed, the hacker interferes and spies on all requests sent by the user to the server as an intermediary [37]. In MITM attacks, the hacker can do the following:

- He can replace your downloaded files with any file you want.
- It sends you to other websites that are not your destination.
- He can see all the history of browsers and types.
- He can connect to your mobile phone if a port is open.

These types of cyber-attacks usually occur in public places that provide WiFi service in places like coffee shops, train and subway stations, restaurants, libraries, and so on. Thus, it is better to never use websites and emails that contain your important information through public WiFi service to protect your information against being hacked by MITM [38].

- Drive-By Attack

In this type of attack, which is a client-side attack, the victim is not guilty of anything other than opening an email or visiting the page where the malware is located. In this method, the hacker directs the victims to a site under his control. In most cases, these codes are so obscure that security systems are unable to detect them [39].

- Brute Force Attacks

Brute force attacks can be considered the most dangerous type of cyber-attacks where chance is a very important factor. To launch a brute force attack, the hacker uses auxiliary tools to test a large number of various passwords for various user emails, like emails and membership accounts, in the hope that one of them will be valid and successful. The simplest ways to prevent hackers from infiltrating by brute force method, selecting a strong username and password for various accounts or admin panel, activating two-step authentication, limiting the number of times to log in again, temporarily blocking the account after several unsuccessful attempts putting a security code in the login process, avoiding repetitive and predictable passwords, using completely meaningless, long passwords and a combination of symbols, numbers and letters. Moreover, it has to be noted that increasing server load and slow site loading speed is one of the consequences of hackers' efforts. To prevent such problems, it is best to restrict access to login pages to the IP address in the htaccess file. If you are using static IP, restrict access to static IP and otherwise to your ISP [40].

- Cookie Stealing

The websites use cookies to identify and grant suitable permissions to a particular user among a large number of users on the website. In Cookie Stealing, the hacker accesses the cookies on your computer and sends them to his browser. Considering the prevalence of cookie theft attacks, many efforts have been made like encrypting or hiding cookies and developing programs that manage and track access to cookies [41]–[42].

- SQL Injection

These types of attacks are conducted using code that is responsible for manipulating the database to access data that is not visible to everyone. This data can be customer personal information, customer lists, or even company sensitive and confidential information. Clearing all data, unauthorized access to the user list, access to the admin panel, and so on are the consequences of a successful SQL injection. However, the biggest damage that these types of attacks incur to businesses is the loss of customer trust in the system because of the theft of their personal information, like address and phone number. To prevent these attacks, important research has been done based on Machine Learning and these attacks have been classified based on Support Vector Machine (SVM) [43]–[44].

- Session Hijacking Attack

Session Hijacking Attack takes place because of a weakness in the TCP/IP protocol. This structural weakness in the protocol allows the attacker to access information on the network. Using this approach, besides stealing information, an attacker can disconnect a particular connection from the network. Dealing with the Session Hijacking Attack is very difficult using the program. Hence, it is better to use the session concealment method to get a more effective result. Moreover, some operational processes have a good effect on detecting network theft operations, which can be detected after the attack [45].

- Insider Threats

Vandalism is not always going to be from the outside. Sometimes a member of the group may disrupt the system for different reasons. These types of threats can be more dangerous than external ones. A person within a set is legally licensed for many accesses, making the job easier for them. Additionally, having a thorough knowledge of the collection and structures facilitates his committing acts of sabotage. Moreover, as security teams focus more on external factors, they are very unlikely to be suspected [46]. Thus, to deal with internal threats, methods based on deep learning (Deep Learning) and machine learning (Machine Learning) have been proposed to detect abnormal behaviors of users within the collection [47]–[48].

Besides the cyber threats already stated, as many smart city applications exchange information through wireless communication networks (like radio waves, WiFi, or RFID), it is necessary to take appropriate security measures regarding this. Wireless networks are often attacked by eavesdropping, jamming, and message injection. Jamming attacks cause sabotage by increasing the error rate and disrupting the radio

waves used in communications and vehicles. Attackers increase the data load and processing of the network to make it harder to track and detect them in traffic to prevent these attacks from being detected. Statistical tools can detect network traffic and abnormal behaviors to detect these attacks [49]. WiFi is vulnerable to man-in-the-middle attacks. This attack is normally characterized as manipulation of messages from sender to receiver by an enemy that goes unnoticed at both ends [50]–[51]. In addition to information security, securing data transmission channels in the context of wireless networks have been presented as effective solutions [52]–[53].

It has to be noted that the threats stated in this section are only a few of the dozens or hundreds of threats that can be faced. Furthermore, with the development of smart cities, more examples are certainly added to these threats as protocols, hardware, and applications in the field of smart cities, new security holes and bugs will be created with the creation of new infrastructure, and it is necessary to process the security review, strengths and weaknesses of smart cities regularly and continuously.

### III. Proposed Security And Privacy Policies For Smart Cities

Before starting the policy discussion, it is important to note that one cannot expect the security of various communities and smart cities to be reached with a copy of policies and laws. Thus, the policymakers in various communities can localize standards related to security and privacy policies, according to their conditions and needs. Here are some general security policies:

- ✓ Firstly, one has to say that the most important part in maintaining and expanding security is policy and policy matters. If the right and comprehensive policies are not adopted, smart cities, even with the best implementation, can become a major threat to the lives, property, and security of the people and the city, and attackers may be able to use the facilities of the smart city like a weapon. Thus, policies must be comprehensive and preventive so that the misuse of facilities is impossible, inadvertently or advertently.

- ✓ Controlling the level of access to the facilities and information of the smart city has to be done accurately and with advanced authentication. This prevents the infiltration of enemies with the format and appearance of citizens and components of the smart city. At the same time, the policies have to be such that all citizens in a variety of situations enjoy transparent facilities and do not get involved in complex enforcement mechanisms.

- ✓ The possibility of errors and problems in rational decisions to provide or not to provide services to humans by machines is inevitable considering the wide scope of monitoring and control of different parts of the smart city. Monitoring and controlling human performance, which can be judged from various aspects (like behavior, personality, emotions, knowledge, history, physiological conditions, etc.), needs systems able to exceed the capabilities of traditional systems and think and make decisions like humans. Thus, the most modern and reliable cognitive methods of artificial intelligence like deep learning (Deep Learning) or cognitive

science (Cognitive Science) should be used to analyze the conditions of applicants and users of information and facilities of smart cities. Moreover, development and research (R&D) about any new facilities that can be used in smart cities to be done continuously and regularly.

✓ Policies in privacy must be such that the personal and confidential information of individuals is kept completely secure in data centers and access to private information should be impossible except in special cases like security issues and with the order of the judge. Furthermore, these acquisitions must be made by law enforcement or network and processing systems with the most comprehensive authentication and encryption algorithms.

✓ It is necessary to analyze and design Top-Down and run and test Bottom-up and step by step given the many complexities, inability to predict some events, and the possibility of missing some points in the analysis, design, implementation, and maintenance of smart cities. This makes the designers and implementers of smart cities not overlook the security of even the smallest component.

✓ Perhaps, sometimes smart city designers and engineers may think of finding complex solutions due to the sensitivity of security and privacy issues, and this is if some difficult issues can be solved with simple solutions. Additionally, one cannot expect a system to be implemented for every culture and society. Hence, it is better to use the crowdsourcing method to get better ideas and solutions, polls about localization of laws and policies, meeting information needs, and identifying audiences and their experiences.

✓ In the analysis and design phase, it is necessary to identify bottlenecks and vital parts of smart cities, from different points of view like infrastructure, equipment, requirements, policies, data centers, network resources, and so on. Then a suitable solution has to be considered to enhance the reliability and scalability of these bottlenecks.

✓ Besides security, other quality criteria like reliability, maintainability, efficiency, integrity, compatibility, robustness, stability reaction time, flexibility, and scalability have been considered in the development and evaluation of smart city management, and precise metrics have been defined to fit each criterion. Crowdsourcing increases the accuracy of measurements for sure. Given the dynamic nature of smart cities, metrics and criteria have to be updated regularly. Overall, Cloud of Things (CoT) (integration of IoT and Cloud Computing technologies) has important and independent criteria and the quality of smart city services based on CoT has been discussed [54]. Additionally, considerable studies have been carried out on the integrity and availability of data and some effective strategic policies associated with privacy and cybersecurity in IoT [55].

✓ Using intrusion detection systems (IDS) and anomaly detection systems in the infrastructure and networks of smart cities like transportation, power plants, hospitals, the behavior of people, and so on could be significantly effective. However, these systems must be updated and reliable. Deep learning has

proven to work better than machine learning techniques. This is because machine learning techniques depend on the extraction of basic features; attackers can find or engineer those features, thereby deceiving smart city systems [56]. Moreover, since machine learning algorithms rely on input data, they become more vulnerable to data manipulation attacks and the production of apparently real data [57]. Nonetheless, as deep learning tolerates small changes in data and works with raw data, they are more resistant to attack. Hence, deep learning-based IDSs have to be taken into account [48]–[58]–[59].

✓ It is necessary to develop smart city management and control simulation software and the performance, strengths, and weaknesses of smart cities in different aspects and the face of events like riots, wars, infiltration, floods, earthquakes, fires and any destruction of infrastructure attacks have to be studied. Moreover, before implementing or adding new components to the smart city in the future, it should be thoroughly reviewed in the simulator environment. Likewise, the smart city simulator should have several options for assessing the degree of privacy protection against all kinds of spyware, malware, and malware.

✓ Considering the society and sometimes the combination of data in data centers, there is a need for reliable data mining methods on a Big Data scale. On the other hand, citizen satisfaction is a fundamental rule in collecting, processing, and extracting knowledge from raw data related to citizens' lives according to the principle of privacy, and continuous citizen satisfaction assessment techniques are necessary given the dynamic nature of smart cities and its components. Indeed, ontology could help formally represent and explore the relationships between satisfaction factors [60].

#### IV. Conclusion

The paper dealt with threats and policies related to security and privacy in smart cities. Considering some cyber threats examples stated, hackers, are increasingly looking for security holes. Different cyber threats await smart cities in the future with the increase in connectivity technologies in smart cities. Hence, the priority in designing and implementing smart cities has to be considering privacy and cybersecurity. Concerning this, various models for each level of architecture, applications, infrastructure, and IT like multi-factor authentication or biometric technologies have been proposed, yet they are not adequate, and dynamic and comprehensive security framework have to be developed given the dynamic and heterogeneous nature of components and elements of smart cities. This is because other challenges continue to exist for real-time and secure heavy-duty processing, more effective solutions may be found with the development of new knowledge like cognitive science. Ultimately, it is essential to note that smart city scientists and developers must fully adjust to the proposed mechanism of their proposed security solutions to existing standards and make sure that the privacy and cybersecurity of smart city users are guaranteed.

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# Factors Affecting At-Grade Railway Level Crossing Accidents in Bangladesh

Armana Sabiha Huq, Tahmina Rahman Chowdhury

**Abstract**—Railway networks have a significant role in the economy of any country. Similar to other transportation modes, many lives suffer from fatalities or injuries caused by accidents related to the railway. Railway accidents are not as common as roadway accidents yet they are more devastating and damaging than other roadway accidents. Despite that, issues related to railway accidents are not taken into consideration with significant attention as a major threat because of their less frequency compared to other accident categories perhaps. However, the Federal Railroad Administration reported nearly twelve thousand train accidents related to the railroad in the year 2014, resulting in more than eight hundred fatalities and thousands of injuries in the United States alone of which nearly one third fatalities resulted from railway crossing accidents. From an analysis of railway accident data of six years (2005-2010), it has been revealed that 344 numbers of the collision were occurred resulting 200 people dead and 443 people injured in Bangladesh. This paper includes a comprehensive overview of the railway safety situation in Bangladesh from 1998 to 2015. Each year on average, eight fatalities are reported in at-grade level crossings due to railway accidents in Bangladesh. In this paper, the number of railway accidents that occurred in Bangladesh has been presented and a fatality rate of 58.62% has been estimated as the percentage of total at-grade railway level crossing accidents. For this study, analysis of railway accidents in Bangladesh for the period 1998 to 2015 was obtained from the police reported accident database using MAAP (Microcomputer Accident Analysis Package). Investigation of the major contributing factors to the railway accidents has been performed using the Multinomial Logit model. Furthermore, hotspot analysis has been conducted using ArcGIS. Eventually, some suggestions have been provided to mitigate those accidents.

**Keywords**— safety, human factors, multinomial logit model. railway.

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# Polyvinylidene Fluoride Based Polymer Electrolyte with Efficient Layered Graphite Filler for Natural Dye-Sensitized Solar Cell

Priyanka Chawla, Mridula Tripathi, Kuamri Pooja

**Abstract**— Graphite nanopowder is synthesized by a mechanical method using a ball mill and used as filler in polymer electrolyte film based on Polyvinylidene fluoride (PVDF) for application in natural dye-sensitized solar cell (DSSC). Simple solution cast technique is employed for the preparation of polymer electrolyte film with incorporation of different weight percent % (1, 2, and 3) graphite filler along with propylene carbonate (PC) and ethylene carbonate (EC) as plasticizers. XRD and DSC analysis is carried out to determine the crystallinity of graphite powder and its glass transition temperature. The film with 2% weight percent shows the best ionic conductivity of about  $1.6 \times 10^{-3}$  S/cm. The betacyanin dye from beetroot and chlorophyll dye from spinach leaves is evaluated for the fabrication of dye-sensitized solar cell (DSSC). The carboxyl, hydroxyl, and porphyrin groups present in these pigments help in binding the dye with the photoanode of DSSCs. Subsequently, a cocktail mixture of the dyes is prepared (1:1) and used in DSSC. The improved absorption spectrum is obtained for cocktail dye in comparison to individual dyes, which aids in improving the overall efficiency of the cell.

**Keywords**— cocktail dye, dye-sensitized solar cell, graphite, polyvinylidene fluoride

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# Assembly of Eco - Friendly Stable Dye-Sensitized Solar Cell with Dyes from Beta Vulgaris and Spinacia Oleracea as Mixed Co -Sensitizer Based on Solid Polymer Electrolyte

Mridula Tripathi, Priyanka Chawla, Kumari Pooja

**Abstract**— The use of extracted betacyanin dye from beetroot and chlorophyll dye from spinach leaves was evaluated in the application of dye-sensitized solar cells (DSSCs). The carboxyl, hydroxyl, and porphyrin groups present in these pigments help in binding the dye with the photoanode of DSSCs. Subsequently, a cocktail mixture of the dyes were prepared (1:1) and used for DSSC. The cocktail dye absorbed a wider range of light in the visible region, thus enhancing the cell efficiency of the cocktail dyes when compared to the DSSC sensitized by individual dyes. Dye-sensitized solar cells (DSSCs) based on redox electrolyte solution sets the limitation and restriction on its fabrication. Moreover, when this redox electrolyte comes in contact with photoanode causes corrosion. The finding of ionic conductivity in polymer material complex with salt has given a breakthrough in the formation of DSSC devices. Polyvinyl alcohol (PVA) based polymer electrolyte has gained considerable interest because of –OH functional group and chemical stability to used as an electrolyte for DSSCs. In the present work, DSSC was fabricated with PVA-based polymer electrolyte film ethylene carbonate as a plasticizer, LiI: I<sub>2</sub> as redox couple and graphite as filler; TiO<sub>2</sub> modified with CuO photoanode in order to provide inherent energy barrier.

**Keywords**— cocktail dye, dye-sensitized solar cell, graphite, polyvinyl alcohol

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# Two-Fluid Modeling Of Sediment Transport In A Vortex-Type Stormwater Retention Pond

Mina Sadat Ahadi and Donald J. Bergstrom

**Abstract**— Designing and optimizing the stormwater ponds for removal purposes without understanding the flow and sediment dynamics is not possible. In spite of the advances in multiphase Computational Fluid Dynamics (CFD) modeling approaches, in the stormwater retention pond CFD modeling, it is common practice to ignore the sediment phase, solve the conservation equations only for the liquid phase, and then to use an advection-diffusion equation for a tracer material. Stormwater retention ponds deal with high sediment loads. Solving an advection-diffusion equation is incapable of bringing in important physics of sediment transport. Exploring sediment removal requires an authentic two-phase model to simulate the flow and sediment dynamics.

A three-dimensional multiphase (flow and sediment) numerical model previously developed and validated in a turbulent open channel flow by the authors is applied to the complex case of an innovative vortex-type stormwater retention pond. The flow pattern in the vortex-type stormwater retention pond was recently characterized experimentally and computationally by the authors. In this study, the sediment and flow dynamics are studied using the two-fluid method. The two-fluid models solve the transport equations for both phases of water and sediment. These models are capable of fully bringing in the physics of sediment transport. The two-fluid models are developing, and their potential is not completely omitted in water resources engineering problems, yet. In this study, the two-fluid model is tested for the first time in a new vortex-type stormwater retention pond. Predictions of the liquid and particle velocity fields based on the two-fluid model framework are presented for two different inflow sediment concentrations. This study provided useful information for the design of stormwater retention ponds as well as highlighting the effect of particles on the flow.

**Keywords**—Computational Fluid Dynamics, Two-fluid model, Sediment transport, Stormwater retention pond.

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# Effect of Birks Constant and Defocusing Parameter on Triple-to-Double Coincidence Ratio Parameter in Monte Carlo Simulation-GEANT4

Farmesk Abubaker, Francesco Tortorici, Marco Capogni, Concetta Sutera, Vincenzo Bellini

**Abstract**— This project concerns with the detection efficiency of the portable triple-to-double coincidence ratio (TDCR) at the National Institute of Metrology of Ionizing Radiation (INMRI-ENEA) which allows direct activity measurement and radionuclide standardization for pure-beta emitter or pure electron capture radionuclides. The dependency of the simulated detection efficiency of the TDCR, by using Monte Carlo simulation Geant4 code, on the Birks factor (kB) and defocusing parameter has been examined especially for low energy beta-emitter radionuclides such as  $^3\text{H}$  and  $^{14}\text{C}$ , for which this dependency is relevant. The results achieved in this analysis can be used for selecting the best kB factor and the defocusing parameter for computing theoretical TDCR parameter value. The theoretical results were compared with the available ones, measured by the ENEA TDCR portable detector, for some pure-beta emitter radionuclides. This analysis allowed to improve the knowledge of the characteristics of the ENEA TDCR detector that can be used as a traveling instrument for in-situ measurements with particular benefits in many applications in the field of nuclear medicine and in the nuclear energy industry.

**Keywords**— Birks constant, defocusing parameter, GEANT4 code, TDCR parameter.

# Price Determination in Competitive Viral Marketing

Heman Shakeri

**Abstract**— We study dynamic price determination for two competitive products adopted by individuals in networks of populations. We consider the optimality of the pricing by strategically choosing the opinion leaders and routes of diffusion using stochastic model where agents are in one of five states: potential buyer, potential buyer exposed to a specific product, and owner of a particular product. Each individual can experience transitions between these compartments; a potential buyer becomes an owner of a particular product by a combination of two different stochastic forces: network externalities and spontaneously depending on the product price. We present our work on how a new brand can survive in this competition by strategically choosing marketing routes and optimally distribute resources in the form of heterogeneous pricing. We present several theoretical results and show efficacy of the findings in a co-location user data.

**Keywords**— Viral Marketing, Diffusion and seeding, Pricing in Online Networks, Network Dynamics.

# Using Cyclic Structure to Improve Inference on Network Community Structure

Behnaz Moradijamei, Michael Higgins

**Abstract**— Identifying community structure is a critical task in analyzing social media data sets often modeled by networks. Statistical models such as the stochastic block model have proven to explain the structure of communities in real-world network data. In this work, we develop a goodness-of-fit test to examine community structure's existence by using a distinguishing property in networks: cyclic structures are more prevalent within communities than across them. To better understand how communities are shaped by the cyclic structure of the network rather than just the number of edges, we introduce a novel method for deciding on the existence of communities. We utilize these structures by using renewal non-backtracking random walk (RNBRW) to the existing goodness-of-fit test. RNBRW is an important variant of random walk in which the walk is prohibited from returning back to a node in exactly two steps and terminates and restarts once it completes a cycle. We investigate the use of RNBRW to improve the performance of existing goodness-of-fit tests for community detection algorithms based on the spectral properties of the adjacency matrix. Our proposed test on community structure is based on the probability distribution of eigenvalues of the normalized retracing probability matrix derived by RNBRW. We attempt to make the best use of asymptotic results on such a distribution when there is no community structure, i.e., asymptotic distribution under the null hypothesis. Moreover, we provide a theoretical foundation for our statistic by obtaining the true mean and a tight lower bound for RNBRW edge weights variance.

**Keywords**— hypothesis testing, RNBRW, network inference, community structure.

# Procyanidins Characterization, Antioxidant and Antifungal Activities of Lingonberry Leaves and Stems

Oana-Crina Bujor, Elisabeta Elena Popa, Mona Elena Popa

**Abstract**— Aerial parts of lingonberry (*Vaccinium vitis-idaea* L.) are used as food and dietary supplements due to their nutritional value and richness in antioxidant polyphenols. In particular, plant phenolic compounds provide antioxidant activity in the protection of dietary lipids from oxidation.

The aim of the present study is to characterize the procyanidins of lingonberry leaves and stems and to evaluate their potential of to be used as antimicrobial agents, as well as antioxidants.

In the present study leaves and stems of lingonberry (*Vaccinium vitis-idaea* L.) were used. Analysis of procyanidins by High Performance Liquid Chromatography (HPLC) following thioacidolysis was applied on powders of leaves and stems. The antifungal activity was studied on two food degradation fungi, *Aspergillus niger* and *Penicillium expansum*, whereas the evaluation of the inhibition of lipid oxidation was performed by autoxidizing methyl linoleate (MeLo). Hydroethanolic (50%) extracts from leaves and stems were prepared by accelerated solvent extraction (Thermo Scientific Dionex ASE 350 extractor) and used for the evaluation of the antifungal and antioxidant activities.

In all samples, the flavanol monomers were detected as (+)-catechin and (-)-epicatechin, the former being highly preponderant. By contrast, almost similar amounts of flavanol monomers were quantified in stems. The lingonberry extracts showed a stronger antifungal activity against *Penicillium expansum*, compared to *Aspergillus niger*. The antioxidant activity (methyl linoleate test) was higher in stems than in leaves extracts.

Results from this study indicate that leaves and stems of lingonberry are suitable for valorization as sources of natural antioxidants and antimicrobial ingredients in foods or as feedstocks for the production of herbal supplements.

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**Keywords**— *Vaccinium vitis-idaea* L., DPPH, antimicrobial agents, thioacidolysis.

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# The Potential Use of Flower Strips on the Biological Control of Wheat Stem Sawfly

Laissa Cavallini, David Weaver, Robert Peterson

**Abstract**— Wheat stem sawfly (WSS), *Cephus cinctus* Norton (Hymenoptera: Cephidae), is a major pest of wheat in North America. It causes losses that exceed \$350 million annually across the Northern Great Plains, which is a semi-arid grassland dominated by intensive agricultural practices, primarily the production of cereal crops. Current land use regimes suppress biotic diversity, sacrificing valuable ecosystem services like biological control of crop pests. Two parasitoids, *Bracon cephi* (Gahan) and *Bracon lissogaster* Muesebeck (Hymenoptera: Braconidae), are well known as biological control agents of WSS. The success of natural enemies is linked to access to supplemental food in the field, and these parasitoids experience increased longevity, egg load, and volume when provided carbohydrate-rich food resources. To assess the availability of floral nectar to parasitoids from wildland flowering species, we conducted surveys in a 12-ha relict native prairie area near Havre, Montana, USA, during the summer of 2019 and 2020. Our site is otherwise similar to non-crop, previously disturbed areas near dryland wheat production. Our results show a high abundance of wildland flowering species during 2019, totaling 29,122 plants and 53 different species. Previous documentation reports that cultivating wildland and other flowering species near host crops increases the benefits of biological control agents in agricultural systems. Knowing that the supplemental food source parasitoids are feeding on has the potential to increase reproductive success, we are also testing cowpea (*Vigna unguiculata* L. Walpers) as extrafloral nectar (EFN) resource for parasitoids. Females were checked daily for longevity and egg size was measured on day 0, 5 and 10. Our results show that EFN increases parasitoids longevity and maintains constant egg load and volume, and thus would be a good source of parasitoid nutrition. In addition, EFN is an open resource easily accessed by these braconids. We hypothesize that not only the use of a cover crop such as cowpea, but also the use of other flowering strips adjacent to wheat fields may be beneficial, contributing to the conservation of natural resources while benefiting both *B. cephi* and *B. lissogaster*. To our knowledge, enhancing native biological controls to directly suppress WSS has never been implemented.

**Keywords**— ecological engineering, flower strips, insect pests, biological control.

# Validation of the Recovery of House Dust Mites from Fabrics by Means of Vacuum Sampling

A. Aljohani, D. Burke, D. Clarke, M. Gormally, M. Byrne, G. Fleming

**Abstract**— Introduction: House Dust Mites (HDMs) are a source of allergen particles embedded in textiles and furnishings. Vacuum sampling is commonly used to recover and determine the abundance of HDMs but the efficiency of this method is less than standardised. Here, we evaluated the efficiency of recovery of HDMs from home-associated textiles using vacuum sampling protocols.

**Methods/Approach:** Living (LMs) or dead (DMs) House Dust Mites (*Dermatophagoides pteronyssinus*: FERA, UK) were separately seeded onto the surfaces of Smooth Cotton, Denim and Fleece (25 mites/10x10cm<sup>2</sup> squares) and left for 10 minutes before vacuuming. Fabrics were vacuumed (SKC Flite 2 pump) at a flow rate of 14 L/min for 60, 90 or 120 seconds and the number of mites retained by the filter (0.4µm x 37mm) unit was determined. Vacuuming was carried out in a linear direction (Protocol 1) or in multidirectional pattern (Protocol 2). Additional fabrics with LMs were also frozen and then thawed thereby euthanising live mites (now termed EMs).

**Results/Findings:** While there was significantly greater ( $p=0.000$ ) recovery of mites (76% greater) in fabrics seeded with DMs than LMs irrespective of vacuuming protocol or fabric type, the efficiency of recovery of DMs (72%-76%) did not vary significantly between fabrics. For fabrics containing EMs, recovery was greatest for Smooth Cotton and Denim (65-73% recovered) and least for Fleece (15% recovered). There was no significant difference ( $p=0.99$ ) between the recovery of mites across all three mite categories from Smooth Cotton and Denim but significantly less ( $p=0.000$ ) mites were recovered from Fleece. Scanning Electron Microscopy images of HMD-seeded fabrics showed that live mites burrowed deeply into the Fleece weave which reduced their efficiency of recovery by vacuuming.

**Research Implications:** Results presented here have implications for the recovery of HDMs by vacuuming and the choice of fabric to ameliorate HDM-dust sensitisation.

**Keywords**— Allergy, Asthma, Dead, Fabric, Fleece, Live, Mites, Sampling.

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# Physiological Regulation of Lignin-Modifying Enzymes Synthesis by Selected Basidiomycetes

Ana Tsokilauri

**Abstract**— The uppermost factor in the regulation of lignin-cellulose activity of decaying white rot or free rot are the substances serving as carbon and nitrogen nutrition of microorganisms and are considered as the most important factor of generative activity of white rot. The research object was Basidiomycete Fungi, peculiar and common in Georgia, and the separation of 10 of them as pure crops. The unidentified pure crops have tasted in order to be determined the potential of synthesis of lignin-degrading enzymes and the substrate of optimal lignocellulose growth. One of the most important aspects of the research conducted on Basidiomycetes was the use of specific lignocellulosic residues for selecting Fungi as a substrate of their growth.

In order to increase lignocellulose with the help of substrate, crops were selected from the screening stage that showed good laccase activity. (Dusheti 1; Dusheti 10; Fshavi 5; Fshavi1; Fshavi 8; Fshavi 32; Manglisi 26; Sabaduri20; Dusheti 7; Sabaduri 1 ),

Among the selected cultures, the crops with good laccase activity against the following substances, in particular: Dusheti 1- in this case, the rate of enzymatic activity on bran substrate was -105,6 u/ml, mandarin-96,4 u/ml. In case of corn - 102,9 u/ml. In case of Dusheti 7- the indicators were as follows: bananas-121,7 u/ml, mandarin-125,4 u/ml, corn - 117,1 u/ml. In the case of Sanaduri 32, the laccase activity was as follows: pomegranate- 101,2 u/ml.

As a result of conducted experiments, the synthesis and activity rates of enzymes depending on plant substrates varied within a fairly wide range, which is still being under research.

**Keywords**— Lignocellulosic substrate, Basidiomycetes, white-rot basidiomycetes, Laccase.

# Feasibility of Sugar Extraction From Lignocellulosic Biomass For The Development of Value-Added Products

Nausheen. Jaffur, Pratima. Jeetah, Gopalakrishnan. Kumar

**Abstract**— The world is currently experiencing a progressive depletion in its exhaustible fossil feedstocks, which also brings in its wake severe repercussions on global warming and climate change. At the present time, resource preservation being an overarching objective of the Circular Economy action plan is not being achieved. Lignocellulosic feedstocks being an inexhaustible organic material can be harnessed into the sustainable production of biofuels bioenergy and biopolymers such as poly lactic acid and polyhydroxybutyrate. This research article aims to provide a comparative analysis on the feasibility of fermentable sugar extraction from several locally available biomass resources such as *Furcraea Foetida*, *Cocos Nucifera L.*, *Pennisetum Purpureum*, *Pandanus Utilis* along with *Arundo Donax* based on their constituents, abundance and fibre properties. Fermentable sugar extraction was conducted on *Furcraea Foetida* constituting of the highest cellulose amount of  $70.14 \pm 1.63$  % via several techniques such as Two-Stage Concentrated Acid Hydrolysis (CAH), Dilute Acid Hydrolysis (DAH), Alkaline Hydrolysis (AH) along with Thermal Hydrolysis (TH) and optimal hydrolysis conditions were devised as per Taguchi Design of Experiments. Maximum fermentable sugar extraction was achieved when *Furcraea Foetida* was hydrolysed with 72 w/v%  $H_2SO_4$  in a two-stage acid hydrolysis as well as with 66w/v%  $H_2SO_4$  in an autoclave for 1 hour in a biomass to acid ratio of 1:10. The hydrolysates and solids were then neutralized, detoxified accordingly and kept for further reaction with Cupriavidus Necator to be transformed into polyhydroxybutyrates.

**Keywords**—Biopolymers, Hydrolysis, Lignocellulosic Biomass, Sugar Extraction

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# Integrate 3D Cloud Points and Multi-Angle Exposure Images to Detect Slight Damage of Taiwanese Temple Painting

Tsung Chiang Wu

**Abstract**—Taiwanese temple painting on wooden structure and stucco wall that are cultural assets with high historical value, due to humid climate and cause serious damage, such as cracks, swellings, shortening, etc. If the damage can be detected at the moment of slight damage, that can reduce the cost of restoration, obtain better restoration results, and indirectly extend its life cycle.

Detecting the damage of Taiwanese temples painting has relied on experienced artisans to make judgments, and scientific methods are to use the relevant images as auxiliary data for interpretation, detecting slight damage using microscope camera and x-ray, but it is not universal and safe. In this study, the traditional god gate painting of Taiwanese temple is used as the research object. Integrate 3D laser scanning technology and reflectance transformation imaging technology to detect the damage. Research results appear the slight damage and 3D space precise coordinates of the door god painting were detected by integrating 3D cloud points and multi-angle exposure images. This method provides painted restoration staff to better understand the location and trend of damage, and can be applied to other types of cultural asset for detecting damage.

**Keywords**—Temple painting, Slight damage, 3D laser scanning, Reflectance transformation imaging

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# A User Experience Study of Military Museum Web Information Architecture

Chih-Hwei Lu, Emmet Yu

**Abstract**—Nowadays, a lot of information and resources are spread and retrieved through the Internet. The impact of internet is wide. It gradually becomes a new way to promote the popularization of military and military education through the internet. National Military Museum of Taiwan has built a virtual military museum website to promote the dissemination of military knowledge and online museum exhibition. Divided into five stages, this study focuses on the users of military museum website. In the first stage, we collected nine military museum websites to analyze the architectures and the labels of the websites. In the second stage, we interviewed the users to understand their demands. In the third stage, we used the card sorting method to understand whether the users were aware of the architecture of the websites and the significance of the naming of the labels. We interviewed the users regarding the users' experiences in the fourth stage. In the fifth stage, we conducted the Usability Test to understand users' experiences, purposes, motivations, preferences, and characteristics in order to know users' behaviors and the problems they encounter. This study has several conclusions. First, we concluded users' opinions towards the architecture and labels of the website through card sorting method and cluster analysis. Then we developed a website of nine-category and 2-level architecture. Second, we got to know users' purposes, motivations, and preferences in using the military museum website. Third, we understood the usability problems regarding organizations, label-naming, search functions, and the interface of operative designs. Finally, this study proposes two suggestions to solve the problems to maintain the military museum website in the future.

**Keywords**—information architecture, user experience, card sorting, military museum

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# The key factors of Engagement in Facebook Fan Pages — A Case Study of Military Museum

Chih-Hwei Lu, Emmet Yu

**Abstract**—Using Facebook as the new type of communication while the number of Facebook’s members increased rapidly. More and more museum take advantage of social media and Facebook, becoming the main channel for these museums to promote themselves. Instead of pursuing the website traffic and the number of “FANS” who like your fan page, museums put more effort on pursuing fan’s loyalty and the adhesive capacity. We can obtain fans’ interests in posts and campaigns by observe their activities on our fan page. This information can become the useful resource for museum to arrange brand marketing and product which suitable these potential visitors. Generalizing Facebook’s business model and the frame by literature review will use to complete this research. The in-depth interview will be used on collecting relative information; in addition, content analyze will be applied on the quality research. The adhesive capacity will be examine by the in-depth interview; thus, fans’ preference will be verified in this stage. Finally, cross analysis is used to analyze the success of brand’s official Facebook fan page. By doing so, this study can provide museums an efficient way to manage their official Facebook fan page.

**Keywords**—Facebook, virtual community, Fan Pages

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# Distributional Lattice Approach For Discovering Syntactic Categories in Child-Directed Speech

Haiting Zhu, Alexander Clark

**Abstract**—Distribution information plays an important role in word categorization. This paper presents a novel distributional approach, distributional lattices to discover syntactic categories. A distributional lattice is a hierarchy formed by closed sets of words that are distributionally similar. In order to empirically support the suggestion that the distributional lattice is extremely effective at categorizing words, this paper presents a distributional lattice analysis of the Brent corpus of child-directed speech. The results show that distributional lattice is able to yield accurate syntactic categories.

**Keywords**—distribution information, distributional lattices, syntactic categories, child directed speech.

## I. INTRODUCTION

Children could form categories by grouping together words that occur in the similar contexts. This idea can be traced back to Harris (1951)'s "discovery procedures" for grammar. A considerable amount of studies has shown that distribution information plays an important role in categorizing words (Gobet and Pine 2005; Clark 2003; Mintz et al. 1995, 2002; Mintz 2002, 2003; Freudenthal et al. 2005; Parisen et al. 2008; Valian et al. 2009; Christodoulopoulos 2011; Ambridge et al. 2014; Moran et al 2018). Although distribution information in linguistic input is potentially useful in categorizing words, questions remain as to what type of distributional structure is especially useful for detecting syntactic categories. In this paper, we propose a novel structure, distributional lattice, to induce categories. The distributional lattice consists of a hierarchy formed by a set of words that are distributionally similar. This lattice structure is potentially useful for capturing syntactic categories by clustering words with associate patterns they occur in. This paper investigates the usefulness of the distributional lattice in identifying syntactic categories.

## II. DISTRIBUTIONAL LATTICE

Lattice analysis is a powerful tool in computer science for data analysis, knowledge representation and knowledge discovery (Wille 1992; Ganter and Wille 1999; Stumme and Wille 2000). Clark (2014) has demonstrated its potential usefulness in syntactic representation in natural language.

There are some formal notions that are fundamental to the understanding of distributional lattices.

Given a set of strings  $S$ ,  $S'$  refers to the set of contexts in which all of the strings in  $S$  can occur. We can invert the relationship between strings and contexts. Given a set of contexts  $C$ ,  $C'$  is defined as the set of strings that can occur in all of those contexts. Therefore,  $S'$  is a map from sets of strings to sets of contexts, and  $C'$  is a map from sets of contexts to sets of strings. We can then combine them together to produce a closure  $S''$ , the set formed by taking all of the strings that can occur in all of the contexts that all of the elements of  $S$  can occur in. A set of strings  $S$  is defined as closed if and only if  $S = S''$  (or  $S = C'$ ). It is a one to one mapping between a set of closed strings and their corresponding contexts. We can infer that for any set of contexts  $C$  the set of strings  $C'$  is closed. It implies that an effective way to define a closed set of strings is by specifying a list of contexts in which these strings can occur. Hence, a closed set of strings is a set of strings that share a given set of contexts. It is a cluster of distributionally similar strings.

An interesting fact about closed sets of strings is that a given string may belong to more than one closed set of strings. These closed sets of strings could form a natural hierarchy with the set of all strings  $\Sigma$  at the very top of the hierarchy and the empty set  $\emptyset$  at the very bottom. This hierarchy is what we called distributional lattice formed by closed sets of strings that are distributionally similar.

Here we use the term string to refer to a word or sequence of words in a language. If a particular string occurs in a sentence, then the context of that string is just the sentence with that occurrence of the string removed and replaced with a gap. For example, the context of the word *can* in the sentences *he can win* and *a can of beer* are respectively *he \_ win* and *a \_ of beer* (where we denote the gap with the underscore symbol). In this case  $can'$  represents the context *he \_ win* and *a \_ of beer*.  $can''$  represents the words that can occur in these contexts (*can*, *may*, *will*, *should* etc.). Fig.1 is a diagram of distributional lattice based on the *can* example.

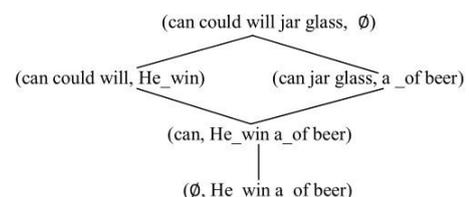


Fig. 1 a diagram of distributional lattice based on the *can* example.

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### III. EXPERIMENT

In this section, we carry out a distributional lattice analysis of the English Brent corpus of the CHILDES (MacWhinney 2000) to explore the usefulness of distributional lattice in syntactic categorization.

#### A. Materials and Methods

We used the English Brent corpus of CHILDES as input corpus and chose the most 100 frequent words as target words (the words to be categorized). For each target word, we extracted the most frequent five contexts in which they occur. Local contexts restricted to immediately adjacent words can be highly informative as to a word's category membership (Mintz et al. 2002, 2003; Redington et al. 1998). In the present approach, we use Mintz's (2003) trigram windows for defining contexts. The trigram context was defined as the joint words immediately preceding and following it. Given the word S occurring in the environment "...X S Y...", its immediately following and preceding words "X Y" were selected as its context for categorization. The original input corpus was then transformed into a trigram corpus so that it was much easier to read contexts of each target word. For some sentences which begin with target words, we added BOUNDARY to their fronts to form a trigram context.

The Choi's (2006) "fast concept lattice algorithm" was used to construct the lattice. In general, this algorithm is able to produce a hierarchy where each node consists of a set of objects and properties for which they share the same values. In this study, words are the sets of objects and contexts are their shared properties. We use Choi's algorithm to produce hierarchies of words and patterns in which they occur.

#### B. Evaluation methods

Correlation threshold for words and contexts was set to make sure that each target word and each selected context are closely related. We used the independent probability (1) to set the correlation value. It states that two events A and B are independent if and only if their joint probability equals the product of their individual probabilities:

$$P(A \cap B) = P(A)P(B) \quad (1)$$

But in (2) if their joint probability is bigger than the product of their probabilities:

$$\frac{P(A \cap B)}{P(A)P(B)} > 1 \quad (2)$$

Two events are not independent but positively related. In order to make sure two events are closely correlated. In this study, event A and event B refer to a word and a context, respectively. In this study, correlation values of 25, 50 and 100 were set for the observed words and contexts.

In order to obtain a quantitative measure of categorization success, two standard measures are widely used: accuracy and completeness (Cartwright and Brent 1997; Redington et al. 1998; Mintz2003). Accuracy is computed by comparing all possible pairs of words in each lattice-based category. It is the percentage of pairs of words grouped together in concept lattice analysis from the same syntactic category. It measures the proportion of Hits to the sum of Hits and False Alarms. A Hit is counted when a pair of items in the lattice category is from

the same syntactic category. A False Alarm is recorded when a pair is from different syntactic categories. Completeness is the percentage of pairs of items from the same syntactic categories correctly grouped together under the lattice analysis. It is calculated as the proportion of Hits to the sum of Hits and Misses. Miss calculated by comparing all possible pairs of words categorized. A pair is recorded as a Miss if its members are from the same syntactic categories but the lattice analysis fails to group them together. In order to calculate Hits, Misses and False Alarms, the categorized words were first labelled with the true syntactic categories they correspond to. The labelling relied on the original POS annotation in CHILDES. Table1 shows major categories of the 100 most frequent words in Brent corpus and their proportions.

TABLE I  
MAJOR SYNTACTIC CATEGORIES OF THE 100 MOST FREQUENT WORDS IN BRENT CORPUS

Syntactic categories	Example	Number	Proportion
nouns	boy, baby, girl	8	7%
verbs	take, see, look	29	26%
adverbs	so, just, right,	24	20%
prepositions	in, on, at,	10	9%
adjectives	big, little, good,	4	4%
pronouns	it, that, them,	18	16%
interjection	hi, hey, yeah	7	6%
auxiliaries(abbreviation)	can, can't, gotta	6	5%
ambiguous categories	you, it, on	13	12%

Besides, a standard way to evaluate the usefulness of the proposed approach is to compare its accuracy and completeness with the performance of random baselines that do not explore distributional information.

#### C. Results and discussion

Table 2 showed that accuracy ranged from 0.73 to 0.90, increasing significantly from the 25 level to the 100 level. Completeness scores ranged from 0.50 to 0.38, decreasing with the correlation level. The mean accuracy and completeness was 0.83 and 0.45, respectively, remarkably higher than baseline (its mean accuracy and completeness was 0.18 and 0.07, respectively).

TABLE 2. ACCURACY AND COMPLETENESS FOR OUR SYSTEM AND FOR RANDOM BASELINE, VARYING CORRELATION BETWEEN WORDS AND CONTEXTS TO 25, 50 OR 100

Correlation	Accuracy	Completeness	Accuracy	Completeness
			Random baseline	Random baseline
25	0.73	0.50	0.13	0.09
50	0.85	0.46	0.19	0.08
100	0.90	0.38	0.21	0.05
mean	0.83	0.45	0.18	0.07

In Table 2 categorization completeness went down with correlation levels. The decline was statistically significant ( $p < 0.01$ ) between 25 and 50. There was an accuracy increase

which was statistically significant ( $p < 0.01$ ) between 50 and 100. The decline outweighed the increase. Thus, we chose the medium 50 level as the optimal correlation. The distributional lattice analysis allowed for identifying a range of categories including verbs, nouns, adverbs, adjectives, pronouns, prepositions, auxiliaries and interjections. Table 3 presented the major categories from the Brent corpus and their accuracy and completeness scores at the 50 level of correlation.

TABLE 3. MAJOR CATEGORIES FROM THE BRENT CORPUS, AND ACCURACY AND COMPLETENESS SCORES AT 50 LEVEL OF CORRELATION

Categories	Observed		Baseline	
	Accuracy	Completeness	Accuracy	Completeness
noun	0.89	0.52	0.11	0.07
verb	0.92	0.19	0.29	0.15
adverb	0.72	0.27	0.19	0.12
preposition	0.79	0.48	0.13	0.04
pronoun	0.86	0.29	0.15	0.11
adjective	0.87	0.75	0.04	0.04
interjection	0.63	0.57	0.05	0.04
auxiliary	0.75	0.84	0.05	0.04
overall	0.85	0.46	0.19	0.08

As mentioned, the observed accuracy and completeness scores were significantly higher than baselines. These high scores indicated that lattice analysis was useful for discovering syntactic categories in child directed speech. The lattice analysis allowed for identifying a wide range of word categories. As Table 3 shows, the majority of the categories have high accuracy: nouns (0.89), verbs (0.92), and pronouns (0.86). Performances on adjectives, adverbs and auxiliaries are also good. Only interjections get a relatively low accuracy score of 0.63.

The major finding is that by operating on a relatively small number of words (the 100 most frequent words), the lattice analysis is able to produce about 80% syntactic categories in the Brent corpus. It is clear from the quantitative results that the categories obtained were highly accurate. The accuracy here is comparable to results in previous approaches that also use distributional information (Cartwright and Brent 1997; Redington et al. 1998; Mintz et al. 2002; Mintz 2003; Chrupala 2012).

#### IV. FROM DISTRIBUTIONAL LATTICE BASED CATEGORIES TO SYNTACTIC CATEGORIES

When it comes to syntactic categories, we have to point out that categories produced by the lattice analysis are not identical to them. There are limits on the extent to which learners could use a pure distributional learning to produce exact syntactic categories.

Early researches have explored the strong correlation between syntactic categories such as nouns and verbs and semantic correlates (Bates and MacWhinney 1982; Pinker 1984, 1987). In the psycholinguistics literature there are several works that make the connection between low-level

distributional representation and syntactic classes via some form of "semantic bootstrapping": a few members of each category are assumed to be known to the learner (e.g. concrete nouns) (Pinker 1984; Mintz 2003), or in the context of "syntactic bootstrapping" (Connor et al., 2012). Lidz and Gleitman (2004) argues that acquisition of syntactic categories occurs in context where a meaning-syntax mapping is available (from naming single concrete objects with nouns to describing events with a number of participants by a verb and its arguments). Indeed, distributional and semantic similarity yields useful syntactic categories. A learning mechanism might be roughly outlined as starting with referring to objects with nouns and probably the personal pronoun *it*, and then name the words occurring before nouns and the pronoun *it* with verbs. With regard to categories like adverbs and auxiliaries that cannot be learned by referring to objects in the world, they are still defined distributionally.

#### V. CONCLUSION

In this paper, a formalism of distributional lattices was used for inducing syntactic categories. The experiment has shown that by operating on a relatively small number of words, most syntactic categories in Brent corpus are accurately detected by the proposed lattice approach with accuracy of 73%-90% and completeness of 38%-50%. The results offer empirical evidence in support of distributional lattice as a basis for detecting syntactic categories.

#### ACKNOWLEDGMENT

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# A Multi-Objective Optimization Tool for Dual-Mode Operating Active Magnetic Regenerator Model

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*Abstract*—This paper proposes an efficient optimization tool for an Active Magnetic Regenerator (AMR) model, operating in two modes: Magnetic Refrigeration System (MRS) and Thermo-Magnetic Generator (TMG). The aim of this optimizer is to improve the design of the AMR by applying a multi-physics multi-scales numerical model as a core of evaluation functions to achieve industrial requirements for refrigeration and energy conservation systems. Based on the multi-objective Non-dominated Sorting Genetic Algorithm 3 (NSGA3), it maximizes four different objectives: efficiency and power density for MRS and TMG. The main novelty of this work is in the simultaneously application of a CPU-parallel NSGA3 version to the AMR model in both modes for studying impact of control and design parameters on the performance. The parametric study of the optimization results are presented. The main conclusion is that the common (for TMG and MRS modes) optimal parameters can be found by the proposed tool.

*Keywords*—ecological refrigeration systems, active magnetic regenerator, thermo-magnetic generator, multi-objective evolutionary optimization, industrial optimization problem, real-world application.

## I. INTRODUCTION

**R**EFRIGERATORS using MagnetoCaloric Materials (MCMs) have been appointed as a promising technology to reduce energy consumption and greenhouse gases. Furthermore, this technology can be used for energy conversion as wasted heat recovery in a low temperature range (below  $100^{\circ}\text{C}$ ). Its working principle is based on the Magnetocaloric Effect (MCE), which manifests as the reversible temperature change near the Curie temperature ( $T_c$ ) in an MCM under a cyclic magnetic field variation. But the MCE is generally small (a few Kelvins per Tesla), whereas at least roughly tens of Kelvins temperature span are needed to respond to industrial specifications. Thus, to attain a commercially workable temperature span between the thermal sources, several thermodynamic cycles are cascaded. In order to perform cascaded cycles, an Active Magnetic Regenerator (AMR) is used. An AMR consists of a porous matrix of MCM, traversed by an alternatively fluid flow, synchronized with a magnetic field variation. More details about the theoretical basis of magnetocaloric technology with examples can be found in [1] or [2]. Despite the development of various prototypes of AMR, commercially relevant performance has not been demonstrated yet. The main challenge in the AMR design is that it is a multi-objective system, where multiple physical phenomena coexist and define its performance. Consequently, in order to improve an AMR prototype, an efficient optimization tool must be able to comprehensively tune multiple parameters in the design space depending on their effect on the non-linear system performance.

Various researches have focused on the performance optimization of Magnetic Refrigeration System (MRS), generally by using numerical models for the simulation of AMR behavior, that consider the underlying modeled physical phenomena [3], [4], [5]. Some research have applied single [6] and multi-objective [7], [8] evolutionary algorithms to the AMR model, taking into account the different physical aspects. Another one [9] uses an artificial neural network, trained on an experimental data set, to predict the energy performance. Together, these works conducted to some improvements and helped to reduce the uncertainty of the performance for the next prototypes [10]. However, an optimization tool with user-friendly interface between an evolutionary algorithm and a code of an AMR model is now required. Moreover, there is a lack of research investigating AMR behavior for two operating modes simultaneously: MRS and Thermo-Magnetic Generation (TMG - targeting energy conversion). Such a study can be done by the optimization of an AMR model performance with a common configuration of geometry and Curie temperature  $T_c$  cascade for both modes.

Taking the above points into account, the goal of this work is dual:

- to provide a multi-objective optimization tool with a simply interface, that permits to investigate the relationship between the variables parameters and the performance of the AMR;
- to optimize energy efficiency and power density in two operating modes (MRS and TMG), for assessing whether it is possible or not to find a common commercially applicable design.

This paper is organized as follows. Section 2 details the proposed optimization tool for the multi-physics multi-scales dual-mode operating AMR numerical model. The experiments and results are shown in Section 3. Finally, Section 4 presents some conclusions.

## II. PROPOSED OPTIMIZATION TOOL FOR THE AMR MODEL

This section outlines the design of a proposed optimization tool for a dual-mode operating AMR model, based on the multi-objective Non-dominated Sorting Genetic Algorithm 3 (NSGA3) [11]. As explained in the introduction, the objective of this tool is to help clarify the relationship between the variable control parameters of the AMR model and its performance in both modes simultaneously.

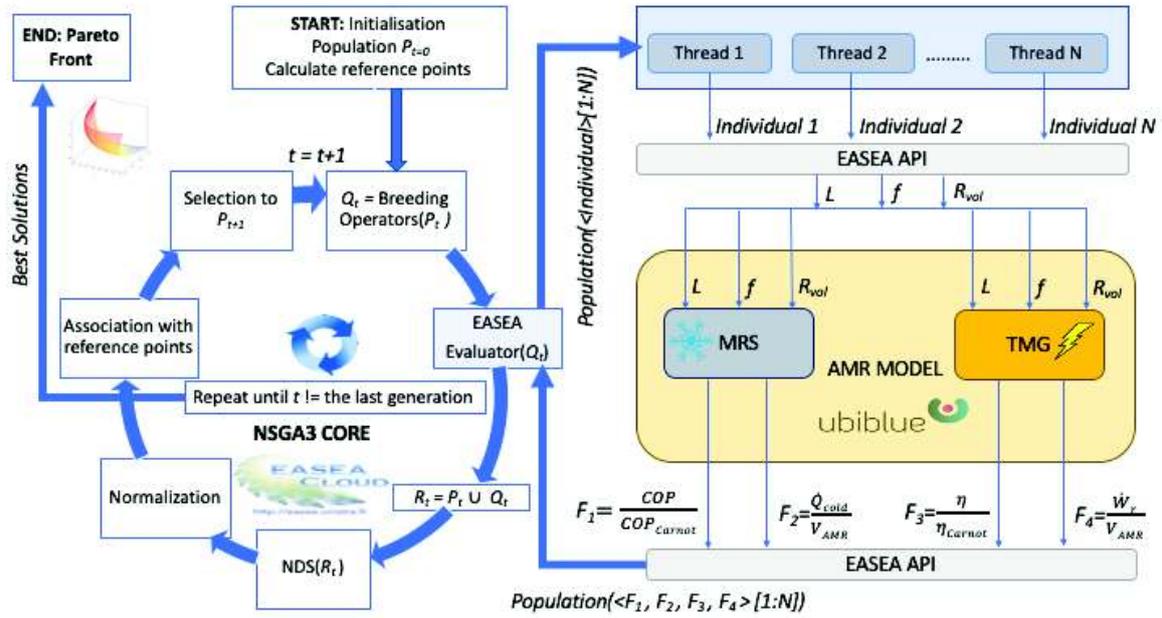


Fig. 1. Structure of the proposed optimization tool for a dual-mode operating AMR model

 TABLE I  
 DEFAULT PARAMETERS OF AMR MODEL CONFIGURATION FOR BOTH OPERATING MODES

Parameter	Value	Unit
Geometry type	parallel plates	[-]
MCMs data set	<i>FeSiLaMnH</i> -based	[-]
Plate thickness	0.4	[mm]
Fluid channel thickness	0.15	[mm]
Magnetic field change value	0 - 0.8	[T]
Temperature span	0 - 65	[°C]
$T_c$ segment layering length	1	[cm]

 TABLE II  
 VARIABLE (DESIGN AND CONTROL) PARAMETERS OF AMR CONFIGURATION FOR BOTH OPERATING MODES

Parameter	Boundaries	Unit	Description
$L$	1-30	[cm]	AMR length along the direction of fluid motion
$R_{vol}$	0.05-1.5	[-]	Ratio of coolant volume transferred at each half AMR cycle on AMR fluid volume
$f$	0.1-10	[Hz]	AMR operating frequency

 TABLE III  
 OUTPUTS OF AMR MODEL

Objective	Unit	Mode	Description
$F1 = \eta = COP/COP_{Carnot}$	[-]	MRS	Energy Efficiency
$F2 = \eta/\eta_{Carnot}$	[-]	TMG	Energy Efficiency
$F3 = \dot{Q}_{cold}/V_{AMR}$	[W/cm <sup>3</sup> ]	MRS	Thermal Power Density
$F4 = \dot{W}_r/V_{AMR}$	[W/cm <sup>3</sup> ]	TMG	Mechanical Power Density

Figure 1 shows the tool structure, which consists of two main parts:

- a dual-mode operating AMR numerical model [10], provided by Ubibblue<sup>1</sup>, in which output parameters are used as evaluation functions in the optimization process (see the right part of Figure 1);
- a multi-objective optimization algorithm NSGA3, integrated to the open source optimization platform EASEA (*EAsy Specification of Evolutionary Algorithms*) [13], [14] (see the left part of Figure 1).

Before explaining how they work together, we briefly describe the Ubibblue AMR model and NSGA3 in the next two paragraphs.

*a) AMR numerical model.:* The complete description of the Ubibblue 3D magnetic – 2D thermal – 1D fluidic numerical AMR model is presented in [10].

First, Table I reports the common AMR configuration for MRS and TMG modes, used for all simulations during the optimization process. The fixed default parameters of this configuration were chosen according to the feedback of previous Ubibblue prototypes and corresponds to a technico-economic optimum.

Second, Table II presents chosen variable parameters, that can have important influence on the AMR behavior and its performance in both operating modes.

$R_{vol}$  and  $f$  are internal operating conditions, that can control the thermodynamic cycles of the AMR, where  $L$  are the design parameters.  $T_c$  of the cascade is selected relatively to the value of  $L$  within the value of the  $T_c$  segment length limitation (see Table I).

Finally, in order to find the combination of internal operating conditions and design parameters ( $R_{vol}$ ,  $f$ ,  $L$ ) for an optimal AMR configuration in both modes, we formulate the optimization problem as a maximization of achievable performance by four objective functions, produced as the output of the AMR model and defined in Table III, where  $COP$  is the Coefficient Of Performance,  $COP_{Carnot}$  is the Carnot Coefficient of Performance,  $\eta_{Carnot}$  is the Carnot yield,  $V_{AMR}$  the AMR volume ratio;  $\dot{Q}_{cold}$  the refrigeration power and  $\dot{W}_r$  the recovery power.

Previous research has shown that the relationship between the internal operating conditions and the AMR performance is not linear [9]. Due to the non-linearity of the problem and the required number of objectives, an appropriate multi-objective optimization algorithm must be chosen.

*b) NSGA3.:* The multi-objective optimization algorithm NSGA3 was chosen as the core of the proposed optimization tool, due to its ability to efficiently handle nonlinear problems with high-dimensional target space (more than 3 objectives). NSGA3 is a genetic algorithm, that uses a non-dominated sorting (NDS) of solution space and widely-distributed reference points for maintaining population diversity. In this work the algorithm is implemented on the base of the original papers, see [11],[12] for the detailed description. The steps of one cycle of NSGA3 are described in Figure 1 (left part).

*c) Optimization Tool.:* In order to simplify the code-coupling process between NSGA3 and the Ubibblue AMR model, NSGA3 is implemented as a template of the open-source EASEA platform. EASEA provides a compiler to automatically turn a problem specification file (\*.ez) of the AMR model with the NSGA3 template, into a CPU parallel C++ code [13]. Moreover, EASEA provides an API, which allows to call the AMR model not only as a C++ function, but also as a binary executable file. Further implementation details are outlined in the EASEA online documentation<sup>2</sup>.

The formulation of this optimization problem was identified as a maximization of four objective functions, presented in Table III by optimizing the values of variables ( $L$ ,  $f$ ,  $R_{vol}$ ) within the boundaries defined in Table II.

Once the problem is formulated, the proposed optimization tool can be run by doing the next four steps:

- to define the problem specification file, as specified by the EASEA documentation and in accordance with the formulation of problem;
- to compile the file containing the AMR model specification with the NSGA3 EASEA template into a C++ parallel code;
- to compile the C++ code (from previous step) into an executable code;
- to run the executable file with the desired number of parallel threads.

Once the tool is run, the NSGA3 CORE starts by randomly generating the initial population (a set of solution candidates of three variables, defined in Table II) and calculating reference points (see Figure 1). Then, the NSGA3 CORE main cycle is run and is repeated until the last generation. In the *EASEA Evaluator* step, several AMR model replicas are executed in parallel as a binary file via the EASEA API, because the Ubibblue AMR model is developed as a SCILAB code. Each replica of the SCILAB code has its own individual as input variable parameters and simulates the AMR model work with them in both operating modes (MRS, TMG). At the end of the simulation, each AMR model replica returns the value of four evaluated objective functions corresponding to its individual and sends them back to the NSGA3 CORE *via* the EASEA API. In the result of the optimization process, the NSGA3 approximates the set of solutions whose projection on the objective space is not dominated by any other feasible solution and returns the Pareto Front of these solutions.

In principle, this tool is versatile and can be applied to different AMR numerical models *via* the EASEA interface (specification problem file). Other different AMR variable parameters and objective functions can be used.

### III. EXPERIMENTS AND RESULTS

Experiments are conducted at the fixed configuration parameters defined in Table I, while the parameters from Table II are varied in the boundary ranges for each AMR composition (individual) as shown in Figure 1. The obtained Pareto Front with non-dominated solutions is presented in Figure 2 with

<sup>1</sup><https://ubibblue.com/>

<sup>2</sup><http://easea.unistra.fr>

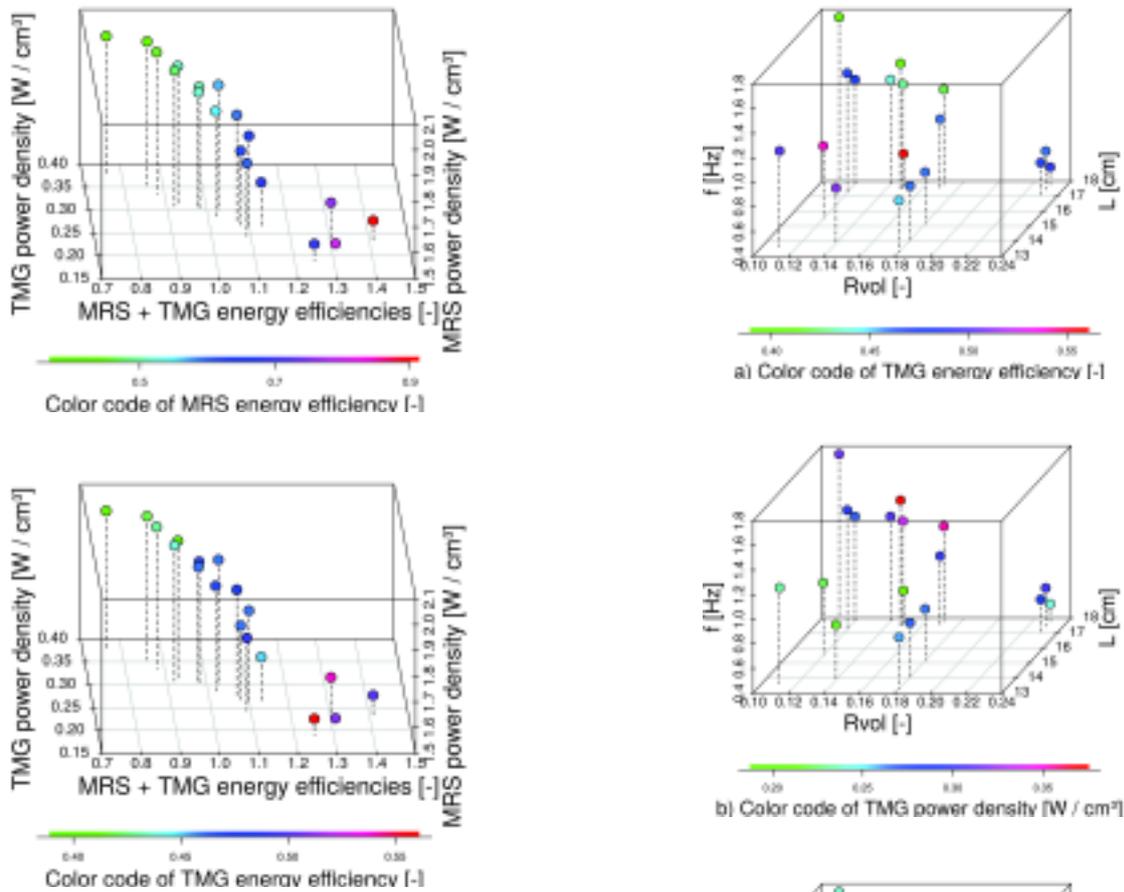


Fig. 2. Obtained Pareto Fronts

highlighted color values showing efficiency in MRS (above) and TMG (below) operating modes. The Pareto front clearly reveals the conflict between the power densities and efficiency in both modes.

A parametric study is conducted to investigate the effects of the variable parameters on the cycle performance through power density and efficiency. To make it clear, Figure 3 reports the distribution of Pareto-optimal solutions:

- Energy Efficiency (TMG): From Figure 3 a) it is seen that the maximum value = 0.56 [-] is obtained for  $L = 17.4 [cm]$ , whereas the values of  $f = 0.69 [Hz]$  and  $R_{vol} = 0.15 [-]$  are moderate. One can notice that the TMG efficiency range is quite small 0.39 – 0.56[-]. It can be explained by the fact that pressure drop is directly proportional to  $L$  and consequently, larger value of pressure drop greater penalizes the energy efficiency in TMG mode.
- Recoverable Mechanical Power Density (TMG): Figure 3 b) shows that the maximum value = 0.37 [ $W/cm^3$ ] is achieved with large values of  $f = 1.45 [Hz]$ , but the values of the other two parameters are almost the same as for maximum efficiency value  $L = 17.2 [cm]$ ,  $R_{vol} = 0.15 [-]$ . Thus, an increase of  $f$  leads to increasing the mechanical power density and efficiency decrease.

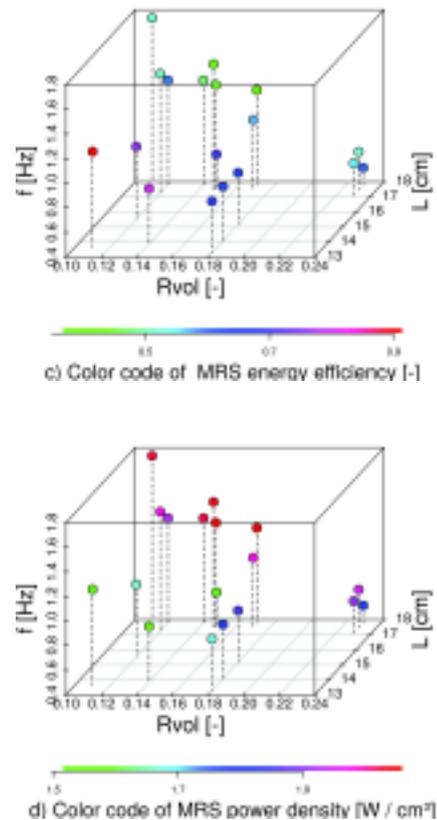


Fig. 3. The distribution of Pareto optimal points solutions

- Energy Efficiency (MRS): the maximum value = 0.56 [-] is obtained with  $L = 13.6$  [cm] with the moderate values of  $R_{vol} = 0.11$  [-] and a quite high value of  $f = 1.18$  [Hz] (see Figure 3 c).
- Thermal Power Density (MRS): Figure 3 d) shows that maximum value = 2,05 [-] is achieved with large values of  $L = 17.8$  [cm] and of  $f = 1.17$  [Hz] with  $R_{vol} = 0.11$  [-].

We can conclude that for all performance values,  $R_{vol}$  has less impact than the others. Also, we notice that according to Figure 3, there are several solutions, which ensure the balance between efficiency and power density for both modes.

#### IV. DISCUSSION

Regarding on the Pareto front, it is noticed, that it has discontinuous shape. It can possibly be explain by the many rejected solutions because of their nonexistence in both modes simultaneously. Consequently, an evaluation of energy conversion system is need to be done by reconsidering some default parameters of AMR model (like the fluid channel thickness), that were optimally set to match a refrigeration system in this study.

The implementation of proposed tool on the base of the EASEA platform enables the use of various single and multi-objective optimization algorithms. It makes this tool independent from the dimension of the solution space and of the target space. The EASEA API makes proposed tool invariant with respect to the programming language of AMR model, as well as to its complexity and configuration. Furthermore, convenient user interface allows to quickly organize an experiment and to obtain the results as Pareto front and the corresponding solutions.

In our future works, we will update the presented tool for an ARM dynamic design problem with a variable dimension of the solution search space. In this case, the number of decision variables changes over time and depends on the results, obtained during previous generations. Explicating this idea further, we are going to investigate the impact of Curie temperature cascade change together with other design and control parameters on the performance in both operating modes simultaneously. In order to do this, the Curie temperature cascade has to be a part of the solution variables of the optimization problem. It should be define as a vector with varying size and this size depends on a value of the another solution variable - the AMR length, obtained during previous generations of evolutionary algorithm.

Considering the positive results of the presented studies, it is suggested that our tool can accelerate the MRS design process, in order to provide the commercially available device, corresponded to modern ecological and energy-saving requirements.

#### V. CONCLUSION

In this work, an efficient user-friendly optimization tool, based on the multi-objective algorithm NSGA3 and EASEA platform is presented. This tool is applied to study the influence of variable control and design parameters of an

Active Magnetic Regenerator (AMR) model to performance in Magnetic Refrigeration System (MRS) and Thermo-Magnetic Generator (TMG) modes. The functionality of proposed tool is centered in four objectives, that allows users to obtain detailed information about relationship between variable parameters and performance of the AMR. Another positive aspect of proposed optimization tool is its universality, because it can be applied for other numerical models of AMR and can be easily adapted to different number of solution variables and objectives. Moreover, thanks to the EASEA API, it can call the AMR model as an executable file or like C++ function. The validation of this tool was done along with the experiments.

It was proved by the experiments that a common design of AMR, which ensures the balance between efficiency and power density can be found for both modes. But the further experiments are needed for taking a larger number of parameters into account.

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# A Study of Supply Chain: Farmers using Aviation and Technology.

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**Abstract**—Due to the COVID-19 pandemic the food supply chain was disturbed at different aspects such as transportation and communication among suppliers and consumers. The pandemic caused for an excess in supply and demand nodes. If this continues it can lead to the exit of suppliers causing for scarcity in the future. The primary objective of this paper is to demonstrate that the transformation of an existing supply chain can be improved to help bring the economy to an equilibrium even during a global pandemic using technology. Methodology included a developed portal that connects demand and supply nodes, and a case study using aviation as a principal method of transportation. The portal helps customers and suppliers identify and match their needs through the website called S&D Marketplace. Furthermore, the case study consisted of a delivery of 500 boxes in a total of 22 small aircraft within the state of California. The findings of this study will provide a foundation for an improved food supply chain among farmers and small businesses.

**Keywords**— Aviation, Farmers, Small Business, Supply Chain, Technology.

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# Barriers and Opportunities in Apprenticeship Training: How to Complete a Vocational Upper Secondary Qualification with Intermediate Finnish Language Skills

Inkeri Jaaskelainen

**Abstract**— The aim of this study is to shed light on what is it like to study in apprenticeship training using intermediate (or even lower level) Finnish. The aim is to find out and describe these students' experiences and feelings while acquiring a profession in Finnish as it is important to understand how immigrant background adult learners learn and how their needs could be better taken into account. Many students choose apprenticeships and start vocational training while their language skills in Finnish are still very weak. At work, students should be able to simultaneously learn Finnish and do vocational studies in a noisy, demanding, and stressful environment. Learning and understanding new things is very challenging under these circumstances, and sometimes students get exhausted and experience a lot of stress - which makes learning even more difficult. Students are different from each other, and so are their ways to learn. Both duties at work and school assignments require reasonably good general language skills, and, especially at work, language skills are also a safety issue. The empirical target of this study is a group of students with an immigrant background who studied in various fields with intensive L2 support in 2016–2018 and who by now have completed a vocational upper secondary qualification. The interview material for this narrative study was collected from those who completed apprenticeship training in 2019–2020. The data collection methods used are a structured thematic interview, a questionnaire, and observational data. Interviewees with an immigrant background have an inconsistent cultural and educational background - some have completed an academic degree in their country of origin while others have learned to read and write only in Finland. The analysis of the material utilizes thematic analysis, which is used to examine learning and related experiences. Learning a language at work is very different from traditional classroom teaching. With evolving language skills, at an intermediate level at best, rushing and stressing makes it even more difficult to understand and increases the fear of failure. Constant noise, rapidly changing situations, and uncertainty undermine the learning and well-being of apprentices. According to preliminary results, apprenticeship training is well suited to the needs of an adult immigrant student. In apprenticeship training, students need a lot of support for learning and understanding a new communication and working culture. Stress can result in, e.g., fatigue, frustration, and difficulties in remembering and understanding. Apprenticeship training can be seen as a good path to working life. However, L2 support is a very important part of apprenticeship training, and it indeed helps students to believe that one day they will graduate and even get employed in their new country.

**Keywords**— apprenticeship training, vocational basic degree, Finnish learning, well-being.

# Human Relationships in the Virtual Classrooms as Predictors of Students Academic Resilience and Performance

Eddiebal P. Layco

**Abstract**— The purpose of this study is to describe students' virtual classroom relationships in terms of their relationship to their peers and teachers; academic resilience; and performance. Further, the researcher wants to examine if these virtual classroom relations predict students' resilience and performance in their academics. The data were collected from 720 junior and senior high school or grade 7 to 12 students in selected state universities and colleges (SUCs) in Region III offering online or virtual classes during S.Y. 2020-2021. Results revealed that virtual classroom relationships such as teacher-student and peer relationships predict academic resilience and performance. This implies that students' academic relations with their teachers and peers have something to do with their ability to bounce back and beat the odds amidst challenges they faced in the online or virtual learning environment. These virtual relationships significantly influence also their academic performance. Adequate teacher support and positive peer relations may lead to enhanced academic resilience, which may also promote a meaningful and fulfilled life academically. Result suggests that teachers should develop their students' academic resiliency and maintain good relationships in the classroom since these results in academic success.

**Keywords**— virtual classroom relationships, teacher-pupil relationship, peer-relationship, academic resilience, academic performance.

# Chemical Warfare Agent Simulant by Photocatalytic Filtering Reactor: Effect of Operating Parameters

Youcef Serhane<sup>A</sup>, Abdelkrim Bouzaza<sup>A</sup>, Dominique Wolbert<sup>A</sup>, Aymen Amin Assadi<sup>A</sup>

**Abstract**—Throughout history, the use of the chemical weapons is not exclusive to combats between army corps, some of these weapons are also found in very targeted intelligence operations (political assassinations), organized crime and terrorist organizations. To improve the speed of action, important technological devices have been developed in recent years, in particular in the field of protection and decontamination techniques to better protect and neutralize a chemical threat.

In order to assess certain protective, decontaminating technologies or to improve medical countermeasures, tests must be conducted. In view of the great toxicity of toxic chemical agents from (real) wars, simulants can be used, chosen according to the desired application.

Here, we present an investigation about using a photocatalytic filtering reactor (PFR) for highly contaminated environments containing diethylsulfide (DES). This target pollutant is used as a simulant of CWA, namely of Yperite (Mustard Gas).

The influence of the inlet concentration (until high concentrations of DES (1200 ppmv, i.e. 5 g/m<sup>3</sup> of air) has been studied. Also, the conversion rate was monitored under different relative humidity and different flow rates (respiratory flow - standards: ISO / DIS 8996 and NF EN 14387 + A1).

In order to understand the efficacy of pollutant neutralization by PFR, a kinetic model based on the Langmuir–Hinshelwood (L–H) approach and taking into account the mass transfer step was developed. This allows us to determine the adsorption and kinetic degradation constants with no influence of mass transfer.

The obtained results confirm that this small configuration of reactor presents an extremely promising way for the use of photocatalysis for treatment of to deal with highly contaminated environments containing real chemical warfare agents. Also they can give birth to an individual protection device (an autonomous cartridge for a gas mask)

**Keywords**—Photocatalysis, photocatalytic filtering reactor, diethylsulfide, chemical warfare agents.

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# Is Colonial Guilt Rational?

Lukas P. op de Beke

**Abstract**— Western European countries have lately come under intense moral scrutiny regarding their colonial past. Interestingly, most of this scrutiny has come from within the ranks of these countries' citizen-bodies, often from citizens more attuned to the evils of colonialism due to their ancestors' status as colonial subjects. In bringing to bear more variegated perspectives on their nation's history, it has appeared that not only is the full scope of colonial wrongdoing poorly understood, it is also yet to be acknowledged appropriately and accounted for. Some Western European countries, or their governments, to be precise, have responded by launching historical investigations into the colonial period to get a better understanding of colonial wrongdoing. Likewise, some have sought to make amends by offering apologies by their heads of state and officials, often accompanied by an expression of regret and sometimes hinting at guilt and remorse. Because of these policies, the question remains whether this is enough, too much, or whether that is simply unclear since apologies can mean different things. Thus, the philosophical question about a nation's colonial past still stands. This question is usually framed in terms of 'what sort of rectification former colonial powers owe to whom.' This paper frames the question differently; that is, it asks about the stance or moral attitude that it is appropriate for former colonial powers to adopt when facing their colonial legacy. Specifically, it seeks to debunk the claim that sees the proper stance as comprising guilt, moral responsibility, or culpability. Having stated this claim as strongly and plausibly as possible, it is then argued—without denying in the least the scope and severity of colonial wrongdoing and the former colonial powers' roles as perpetrators—that colonial history was susceptible to various types of luck to such a degree that it would be irrational for former colonial powers to adopt a stance of colonial guilt. In rolling out this argument, many turn on a conceptual discussion of various types of luck and applying these to colonialism. Finally, having rejected guilt as an appropriate stance, the paper concludes with two other stances: a morally utterly innocent stance and a stance that expresses 'agent-regret'—a term borrowed from Bernard Williams. The paper argues that while both are rational for former colonial powers to adopt, the latter stance is preferred from a moral point of view.

**Keywords**—apologies, colonialism, guilt, moral responsibility

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# Ocular injuries induced by Sulfur Mustard after Eye Vapor Exposure in Rabbits

Fanny Caffin, Fanny Gros-Désormeaux, Alexandre Igert, Francois Fenaille, Emeline Chu-Van, Florence Castelli, Daniel Léonço, Christophe Junot, Christophe Piérard

**Abstract**—A century after its first military use on the battlefield, sulfur mustard (2,2'-dichlorodiethyl sulfide; SM; also known as mustard gas) remains an agent of the threat. Indeed, there is evidence or allegation of SM use in recent conflicts, mainly in the Middle East. SM is a strong alkylating agent with cytotoxic, mutagenic, and vesicating properties, known for its ability to induce eye, skin, and respiratory injuries and long-term complications. Among these effects, ocular damages are the most immediate incapacitating. Furthermore, a minority of victims will suffer from chronic ocular complications. Unfortunately, the management of SM-induced lesions represents a challenge yet, due to the fact that neither antidote nor specific treatments are available. In order to offer better support to victims after an accidental or terrorist ocular SM exposure, we used a SM vapor exposure technique in a rabbit ocular model to investigate specific and non-invasive ocular biomarkers after ocular SM intoxication. Depending on the results obtained, a rapid screening kit for biomarkers in tears may be developed. Firstly, we developed a relevant *in vivo* model that produce severe ocular SM-induced lesions. Thus, we used 11 New Zealand white female rabbits, weighing 2-3 kg. Animals were divided into two groups: unexposed animals (SHAM = 4) and exposed animals (SM = 7). Under anesthesia, only the right eye (RE) of SM group animals was exposed to neat SM vapor (10 $\mu$ L, 1300 mg/mL), using the cap method, ranging from 2 minutes to 6 minutes. After exposure, animals were monitored for up to 2 weeks. A series of standardized clinical measures and biological fluid samples (tears, blood, and urine) were performed up to the end of the protocol. Effects of SM exposure on intraocular pressure (IOP) were measured every day by rebound method with TonoVet Plus® (TV+) device. Moreover, central cornea thickness (CCT) were evaluated on anesthetized animals (on J0 and J+15) using PachPen pachymeter. At the end of the experiment, animals were euthanized, and multiple organs, including eyes, were dissected and kept frozen until metabolomics analyses and UHPLC-MS/MS quantification. These analyses were processed in a second time. Preliminary clinical results highlighted that up to 1 day after a single acute neat SM ocular exposure, compared to the control eye (left eye (LE) of the same animal) or SHAM group, SM rabbits developed an inflammation of the anterior segment characterized by corneal edema. The ocular swelling process is transient and starts to resolve itself after two weeks. Likewise, from 24h post-exposure, animals exhibited a decrease in IOP (6min group; SHAM RE: 19.0  $\pm$  0.6 mmHg; SHAM LE: 17.5  $\pm$  0.9 mmHg; SM RE: 13.0  $\pm$  0.7 mmHg; SM LE: 18.2  $\pm$  2.1 mmHg). In addition, from 2 weeks post-exposure, CCT is still increased compared to controls.

In summary, the present data showed that single local eye intoxication with neat SM, induced long ocular effects. Our results are in accordance with the publications using this *in vivo* model and also with clinical observations in Iranian veterans.

Our model can be use to complete our research on specific ocular biomarkers after SM intoxication, and for other studies, including research of medical counter-measures and treatments of ocular SM-induced lesions.

**Keywords**—biomarkers, chemical warfare agent, ocular injury, sulfur mustard

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# Emotional Processing Difficulties in Recovered Anorexia Nervosa Patients: State or Trait

Telma, Sandra, Maria, Isabel Castro, Torres, Araujo, Brandao

**Abstract**— Objective: There is a dearth of research investigating the long-term emotional functioning of individuals recovered from anorexia nervosa (AN). This 15-year longitudinal study aimed to examine whether difficulties in cognitive processing of emotions persisted after long-term AN recovery and its link to anxiety and depression. Method: Twenty-four females, who were tested longitudinally during their acute and recovered AN phases, and 24 healthy control (HC) women, were screened for anxiety, depression, alexithymia, and emotion regulation difficulties (ER; only assessed in recovery phase). Results: Anxiety, depression, and alexithymia levels decreased significantly with AN recovery. However, scores on anxiety and difficulty in identifying feelings (alexithymia factor) remained high when compared to the HC group. Scores on emotion regulation difficulties were also lower in HC group. The abovementioned differences between AN recovered group and HC group in difficulties in identifying and accepting feelings and lack of emotional clarity were no longer present when the effect of anxiety and depression was controlled. Conclusions: Findings suggest that emotional dysfunction tends to decrease in AN recovered phase. However, using an HC group as a reference, we conclude that several emotional difficulties are still increased after long-term AN recovery, in particular, limited access to emotion regulation strategies, and difficulty controlling impulses and engaging in goal-directed behavior, thus suggesting to be a trait vulnerability. In turn, competencies related to emotional clarity and acceptance of emotional responses seem to be state-dependent phenomena linked to anxiety and depression. In sum, managing emotions remains a challenge for individuals recovered from AN. Under this circumstance, maladaptive eating behavior can serve as an affect regulatory function, increasing the risk of relapse. Emotional education and stabilization of depressive and anxious symptomatology after recovery emerge as an important avenue to protect from long-term AN relapse.

**Keywords**— alexithymia, anorexia nervosa, emotion recognition, emotion regulation.

# The Effects of an Online Career Intervention on University Students' Levels of Career Adaptability

Anna Veres

**Abstract**—People's ability to adapt to a constantly changing environment is essential. Career adaptability is central to Career Construction Theory, where proper adaptation to new situations, changing environments, and jobs require adequate career development. Based on current career theories and the possibilities offered by digital technology, the primary goal of this study is to develop career adaptability through an online tool. Its secondary goal is to apply for an online career intervention program and explore its developmental possibilities. A total of 132 university students from the bachelor program took part in the study, from which 65 students received a four-week online career intervention, while 67 participants formed the control group. Based on the results, it can be stated that career adaptability can be developed, and there is a great demand and interest from university students to use career-related programs on online platforms. Career interventions should be performed online as well if there is suitable software and a well-constructed program. Limitations and further implications are discussed.

**Keywords**—Career adaptability, career development, online career intervention, university student.

## I. INTRODUCTION

INFORMATION and communication technology (ICT) is now available in almost every area of life. Career counseling is no exception, as in recent decades, ways of incorporating ICT into a career, counseling has been increasingly explored [3], [4].

Several studies have shown that users are interested in developing their career-related competencies on an online platform [4], [5]. Users are curious about the opportunities offered by computers and programs. These programs seem to be useful in a certain way. As soon as computers or software were used in counseling sessions, studies appeared examining the impact of these new tools, often compared to traditional face-to-face career counseling. The following is an overview of the types of interventions that have been used in some way to promote career development.

An online career guidance program for career maturity has been successful with high school students; those who have participated in online intervention have shown significant growth in their career maturity level [6]. An earlier study was similarly successful where it was found that online narrative based on career interventions was effective in career counseling, as participants exhibited less career indecision and more career certainty [7].

To facilitate occupational exploration and career decision making, there was another successful internet-delivered career

development intervention, called Career HOPES, where the participants in the treatment group showed greater scores in career decidedness than the control group [8]. More recent research shows that career and self-construction helped high school students manage their career-related transitions [9].

In their research, Nota et al. [10] investigated how effective an online career intervention, based on life design principles, can be. Primary school students participated in the study, and they formed a group of online and traditional career interventions. Pre-test and post-test measurements were compared and concluded that students who received the online intervention had a higher level of career adaptability and life satisfaction.

In another study where the aim was to improve career development, the impact of an online career intervention was investigated. Some of the research participants received face-to-face counseling and another group, online career counseling. The results showed that both online and face-to-face interventions increased students' career development levels compared to the control group [11]. So, there was no difference between the two modalities. Nevertheless, one of the meta-analyses that investigated the treatment modalities in career counseling concluded that the use of a computer system supplemented by the presence of a counselor face-to-face was more effective than the computer-based exercises and tasks alone [1]. In the most recent meta-analysis, similar results were found, where the effectiveness of career choice interventions was investigated. It has been found that the effectiveness of computer intervention alone or predominantly computer-based intervention was much lower than that of traditional intervention [2].

Balanced career development involves the fact that in difficult times, the individual can adequately solve his or her career problems. The reasons for large university drop-out rates may be due to several reasons, such as the inability to decide or lack of information [12]. Therefore, it is worth examining and discussing career development in the context of dropping out. In Romania, the drop-out rate of students enrolled in university is very high [13], meaning that they do not complete their Bachelor's Degree (BsC). The same is true for university students who choose to help professions, as in this case there is also an enormous proportion of students who do not finish their studies, between 30-45% of the enrolled students drop out already in the first year [31]. There are several reasons for the high drop-out rates, which can be well explained by the career

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barrier model [14]. There may be a lack of motivation and general inability to make decisions, so the choice of degree will only be a minor bad or a decision suggested by the environment. Another reason may be inadequate information and inconsistent information about the faculty, which causes the student not to get what he/she expected, which will make it easier for him/her to leave the program or freeze it. All this was well supported by a study conducted at Babes-Bolyai University in 2014, confirming that students have little information about job opportunities, expectations are not in line with their knowledge and abilities, and they do not have a coherent plan. In addition, they face many obstacles in their career decision-making process as well [12]. So, bearing in mind that students perceive many obstacles in their career development and the popularity of online career counseling platforms, the study attempted to facilitate their career development with an online program where students specifically develop their career adaptability.

Job diversity and rapid change in career development also require the person to be constantly adapted to different roles [15]. In other words, the existence of career adaptability is vital for smooth career development. Career adaptability itself is defined by Savickas [16] as “a psychosocial construct that denotes an individual’s readiness and resources for coping with current and imminent vocational developmental tasks, occupational transitions, and personal traumas” (p.51). Savickas [17] describes the four dimensions of response readiness and coping resources that constitute career adaptabilities, such as concern, control, curiosity, and confidence. He conceptualized adaptive individuals as:

1. “Becoming *concerned* about their future as a worker.
2. Increasing personal *control* over their vocational future.
3. Displaying *curiosity* by exploring possible selves and future scenarios.
4. Strengthening the *confidence* to pursue their aspirations.” (p.52).

Several studies show that career adaptability (CA) (and life satisfaction (LS)) can be improved by traditional 6-week interventions [18], or by a one-day intense training [19], or by 3 sessions of an online intervention [10].

Based on preliminary research, this study focused on the career development outputs of CA and career satisfaction. To make the intervention online, professional web developers created a website ([www.karrier-labor.ro](http://www.karrier-labor.ro)) where the students can spend one and a half hours each week on career-related tasks for four weeks. To sum up, the paper is attempting to increase the CA of college students through the use of an online program developed by specialists.

#### A. The Purpose of the Study

In this study, an intervention was developed that combines elements of self-knowledge with elements of career construction intervention, all in favor of a clearer insight [20], [21], and better management of career transition [22].

The main aim was to effectively improve CA as an adaptability resource, which will be revealed in the students’ career paths, taking into consideration that professions and job requirements are constantly changing. On the other hand,

another goal was to test the effectiveness of an online career intervention and the extent to which such interfaces are needed when it comes to career construction.

#### B. Objectives

The main objectives of this paper is to create and to develop an online platform that promotes career development.

- H1. Compared to a control group, the experimental group will show an increase in CA (in terms of career concern, control, curiosity, and confidence), immediately after the intervention and six months later.
- H2. Compared to a control group, the experimental group will show an increase in career satisfaction immediately after the intervention and six months later.

## II. METHODS

#### A. Sample

A total of 132 university students from the bachelor program took part in the study, from which 49.2% (n = 65) formed the training group and 50.8% (n = 67) formed the control group. All the students completed the pre-training measurement (Time1) and the post-training measurement (Time 2), and only 92 students (69.69%) completed the follow-up measurement six months later (Time 3). From these students, 50 participants (54.3%) formed the control group, and 42 participants (45.7%) formed the experimental group. The final sample that had participated in the follow-up well consisted of 81 women (88%) and 11 men (12%) with a mean age of 21.2 (SD = 1,98) years. All participants were from the Faculty of Psychology and Educational Sciences and from the Faculty of Sociology and Social Work.

#### B. Instruments

After collecting the demographic data, the participants filled out the *CAAS-Hungarian Form* [23] in order to measure concern, control, curiosity, confidence, and in total, CA. The CAAS-International contains 24 items that are combined to form a total score that indicates CA [22]. The CAAS-Hungarian Form has only 23 items due to one missing item, which did not satisfy the procedure of validation. The scale is divided into four subscales that measure the adaptability resources of concern (6 items), control (6 items), curiosity (5 items), and confidence (6 items).

Participants responded to each item choosing a scale from 1 (not strong) to 5 (strongest).

The concern subscale measures how consciously a person is prepared for future tasks. The control subscale indicates the degree of responsibility for shaping their own career path. Curiosity refers to the extent to which an individual is willing to explore his or her opportunities and resources. In this context, confidence means self-confidence, which has an important role in dealing with vocational or career tasks [22].

The career satisfaction was measured with a five-item *Career Satisfaction Scale* developed by Greenhaus et al. [24]. On our sample reliability, it was good ( $\alpha = .86$ ).

To investigate social validity, four questions were asked in the experimental group after the intervention, at post-test

(Time2). With these four questions, the aim was to explore how useful the program was to the users. The first three questions were the following: *How useful was it to solve online tasks and fill out questionnaires? How useful do you find the emails sent with the results? How useful were the reminders?* The following answers were given to choose from: *Very useful, Useful, Rather useful, Rather not useful, Not useful, Not useful at all*. In the fourth question, we asked which modality is more preferred (*Would you prefer the online tasks and questionnaires or the paper-pencil form?*) There were four answers: Paper pencil form, Online form, Indifferent, or Other.

### C. Design and Procedure

The purpose of the longitudinal field quasi-experimental study was to examine the extent to which the use of an online career program affects the career development of students. More specifically, individuals in the study were compared across CA and career satisfaction. The two groups we compared were those who participated in a four-week online career intervention (training group) and those who did not (control group). The pre-test was taken during the seminars a few days before the intervention (Time 1), while the post-test data was collected right after the intervention (Time 2) and the follow-up data were gathered through email six months after the intervention (Time 3). Both experimental and control groups were recruited from the Faculty of Psychology and Education. The experimental group consisted of students who met each week at a given seminar. Although the two groups were not randomized, there was no significant difference between the control group and the experimental group at the pre-test. The participants volunteered and used their data anonymously and signed a consent statement.

### D. Career Intervention-Training Process

The structure of the online platform was specially designed for this study (Fig. 1). The structure and process of the follow-up modules were based on the combination of theoretical work by Brown and Krane [20], The Life Design Group Guide by Barclay and Stoltz [21], and suggestions from career counselors. We also took into consideration that online self-assessment, which is the main part of the intervention, should include not only scoring but also an individual interpretation of the scores, and if it is the case, recommendations for future actions.

The modules were completed during seminars, 30-40 minutes/module, one module/week.

After a student had registered to the website, they received a confirmation email, and they could easily start the program following the instructions. Table 1 presents the structure of the online intervention.

Each student from the experimental group participated in a four-week online program with activities related to their career development. Firstly, a career counselor introduced the site where they registered with their email address and agreed to their data being used anonymously. After the registration, the first module started, where two tests were completed and then interpreted. In the first module, participants completed a 60-

item version of the HEXACO Personality Test to find out which personality type fits them the most (Honesty-Humility, Emotionality, Extraversion, Agreeableness (versus Anger), Conscientiousness, Openness to Experience). The results were sent via email, and they could be analyzed and interpreted. After the HEXACO, they filled out the RIASEC inquiry questionnaire, which revealed the interests that can be matched to a certain job or career based on their personality. The aim of this module was to explore personality traits and career interests through which the participant develops his/her self-knowledge. The second module was accessible after seven days. In this module, a goal-setting exercise was undertaken to formulate the short, medium, and long-term goals of the participant for certain areas of life. They also received summary feedback via email. The third module was also completed one week later; in this part of the program, future career expectations were clarified, and tasks like categorization and prioritization of value systems were completed. In the last module, the participant had to prioritize his or her work-related values and then make a summary of the role models and activities he/she likes. After completing the four modules, they received a summary email giving feedback on the exercises and giving them the opportunity to participate in additional exercises if they wanted to.

If there was any question about the results, a career counselor was available online to answer. All the results of each module were emailed despite the fact that they had received every piece of information on their profile as well. The participants also received reminder emails informing them of their remaining time to complete the respective module, hoping that these reminders will promote a high participation rate in the research.

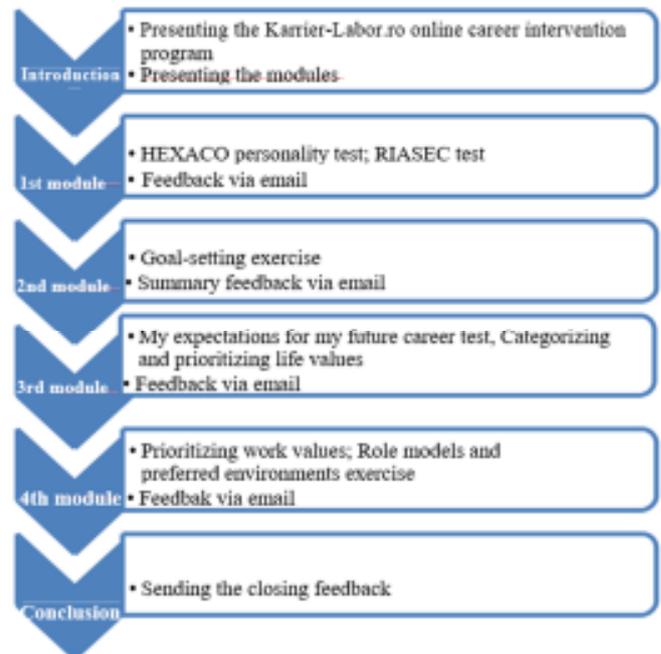


Fig. 1 The structure of the online intervention

### III. RESULTS

#### A. Repeated Measures ANOVAs (Time 1, Time 2)

No differences were found between the two groups on career concern ( $F(1,130) = .51, p = .47$ ), career control ( $F(1,130) = .00, p = .98$ ), career curiosity ( $F(1,130) = .00, p = .97$ ) and career confidence ( $F(1,130) = .77, p = .38$ ), overall CA ( $F(1,130) = .26, p = .61$ ), career cooperation ( $F(1,130) = 1.1, p = .29$ ), career satisfaction ( $F(1,130) = .52, p = .46$ ), LS ( $F(1,130) = .77, p = .38$ ).

Repeated measures analyses of variance (ANOVAs) were conducted to determine whether the development of each dimension of CA was significant and could be ascribed to the training, with the CA measures at each measurement point (pre-training, post-training) as the within-subjects variable and condition as the between-subjects variable.

The interaction condition  $\times$  time was significant for CA ( $F(1, 130) = 12.02, p = .001, \eta^2p = .08$ ; see Fig. 2a), career control ( $F(1, 130) = 4.53, p = .03, \eta^2p = .03$ ; see Fig. 2c) and career curiosity ( $F(1, 130) = 16.59, p = .00, \eta^2p = .11$ ; see Fig. 2d), career confidence ( $F(1, 130) = 5.73, p = .01, \eta^2p = .04$ ; see Fig. 2e), career cooperation ( $F(1, 130) = 11.87, p = .00, \eta^2p = .08$ ; see Fig. 2f); was not significant for career concern ( $F(1, 130) = 3.32, p = .07, \eta^2p = .02$ ; see Fig. 2b). No other significant effects emerged for Career Satisfaction.

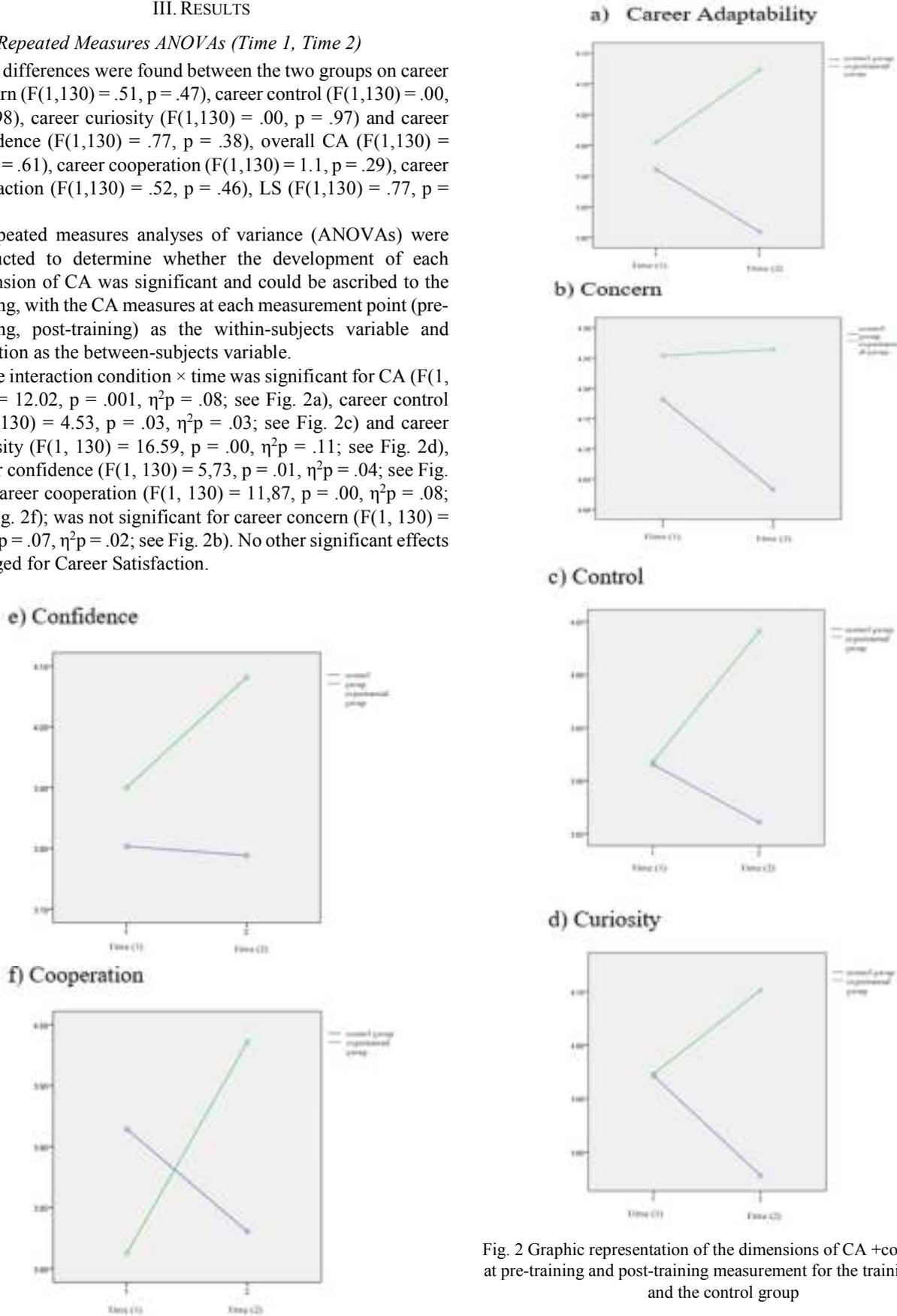


Fig. 2 Graphic representation of the dimensions of CA +cooperation at pre-training and post-training measurement for the training group and the control group

*B. Repeated Measures ANOVAs (Time 1, Time 2, Time 3)*

To make sure that the experimental group and the control group would be comparable, we checked whether the groups differed. No differences were found between the two groups on career concern ( $F(1,90) = .76, p = .38$ ), career control ( $F(1,90) = .03, p = .85$ ), career curiosity ( $F(1,90) = 2.4, p = .12$ ) and career confidence ( $F(1,90) = .28, p = .59$ ), overall CA ( $F(1,90) = .08, p = .77$ ), career satisfaction ( $F(1,90) = .76, p = .38$ ).

To test the first hypothesis that, compared to the control group, the experimental group will show an increase in CA right after the intervention and six months later repeated measures ANOVAs was conducted. Table I displays the means and standard deviations for overall CA and for each dimension of it, and for career satisfaction. Figs. 2 (a)-(f) show the graphic representations of these means. From the figures, we can read that the experimental group scored higher on every dimension at the posttest (Time 2) than at the pretest (Time 1). Also, figures indicate that the experimental group scored higher on control, curiosity and confidence at the posttest measurement (Time 2) and at the follow-up measurement (Time 3) than at the pretest measurement (Time 1).

TABLE I  
VALUES OF THE DIMENSIONS OF CAREER: ADAPTABILITY, OVERALL CA AND CAREER SATISFACTION AT PRETEST, POSTTEST AND FOLLOW-UP MEASUREMENT FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP

Dimension	Group	Pre-test (T1)		Post- test (T2)		Follow-up (T3)	
		D	D	D	D	D	D
Career	Control	.01	.47	.85	.59	.02	.48
Adaptability	Experiment	.98	.47	.10	.46	.05	.48
Career	Control	.26	.50	.02	.64	.21	.53
concern	Experiment	.26	.61	.28	.58	.21	.60
Career control	Control	.95	.66	.86	.69	.04	.60
	Experiment	.92	.65	.05	.60	.07	.62
Career	Control	.02	.50	.79	.65	.95	.59
curiosity	Experiment	.85	.51	.00	.55	.97	.56
Career	Control	.80	.65	.74	.72	.86	.61
confidence	Experiment	.87	.58	.07	.59	.95	.66
Career	Control	.00	.57	.87	.68	.79	.84
satisfaction	Experiment	.89	.65	.89	.74	.80	.67

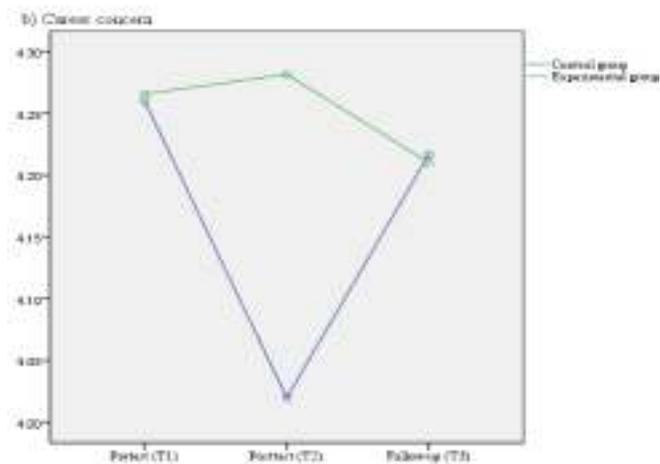
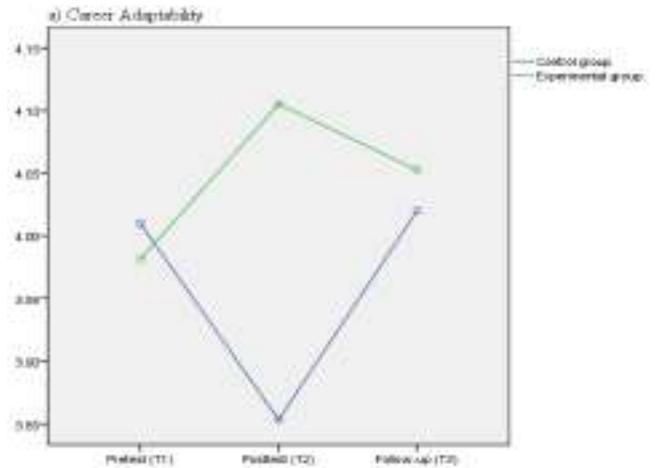
N Experiment = 42 N Control = 50

Repeated measures ANOVAs were conducted in order to determine whether the development of each dimension of CA and career satisfaction was significant and could be ascribed to the intervention.

Results showed that the interaction condition  $\times$  time was significant for CA ( $F(2, 180) = 5.87, p = .00, \eta^2p = .06$ ; see Fig. 3 (a)), career curiosity ( $F(2, 180) = 5.35, p = .00, \eta^2p = .05$ ; see Fig. 3 (d)), career confidence ( $F(2, 180) = 3.12, p = .04, \eta^2p = .03$ ; see Fig. 3 (e)); and was not significant for career concern ( $F(1, 171.83) = 3.95, p = .05, \eta^2p = .04$ ; see Fig. 3 (b)), career control ( $F(2, 180) = 2.37, p = .09, \eta^2p = .02$ ; see Fig. 3 (c)) and career satisfaction ( $F(2, 180) = .56, p = .57, \eta^2p = .00$ ; see Fig. 3 (f)).

The results show that CA started to increase in the experimental group and to decrease in the control group, but in the long run, the growth in the experimental group decreased. The situation is similar in the concern and curiosity and confidence subscales, but in the case of career control, there is

a long-term increase in the experimental group. In terms of career satisfaction, this value started to increase slightly in the experimental group, but unfortunately, in the long run, there was no significant increase in career satisfaction.



and the control group

*C. The Subjective Usefulness of the Program as Perceived by the Students*

During the post-test (Time 2), which had a total of 65 participants, each participant completed a questionnaire aimed at finding out how useful the online interface was. As the career intervention program is still in an experimental phase, we were curious about the program and the usefulness of its elements.

To the question of “How useful was it to solve online tasks and fill out questionnaires?” the answers were the following (Fig. 4 (a)): 77.9% found it very useful, 14.4% found it useful, 5.3% found it more useful, and 0.8% found it less useful, 0.8% did not find it useful and 0.8% did not find it useful at all.

It was interesting to explore to what extent the results sent via email were useful, as the results could be viewed on the page profile as well. Despite that, one third (33.8%) of the participants found the emails very useful, 46.2% useful, 12.3% more useful, while the remaining 7.6% thought that the emails containing the result were not very important (Fig. 4 (b)).

Investigating the objective usefulness of the reminders sent via email the results are the following: 20% responded that they were very helpful, 37.5% said that they were useful, 28.1% rather useful, and the remaining 14% did not find the reminders useful (Fig. 4 (c)).

Finally, regarding their preference to the modality for completing the tasks and the questionnaires, it turned out that no one prefers just paper-pencil form, 9.4% of the participants answered that the form does not matter for them, but the majority (90.6%) preferred the online version of the tasks and questionnaires (Fig. 4 (d)).

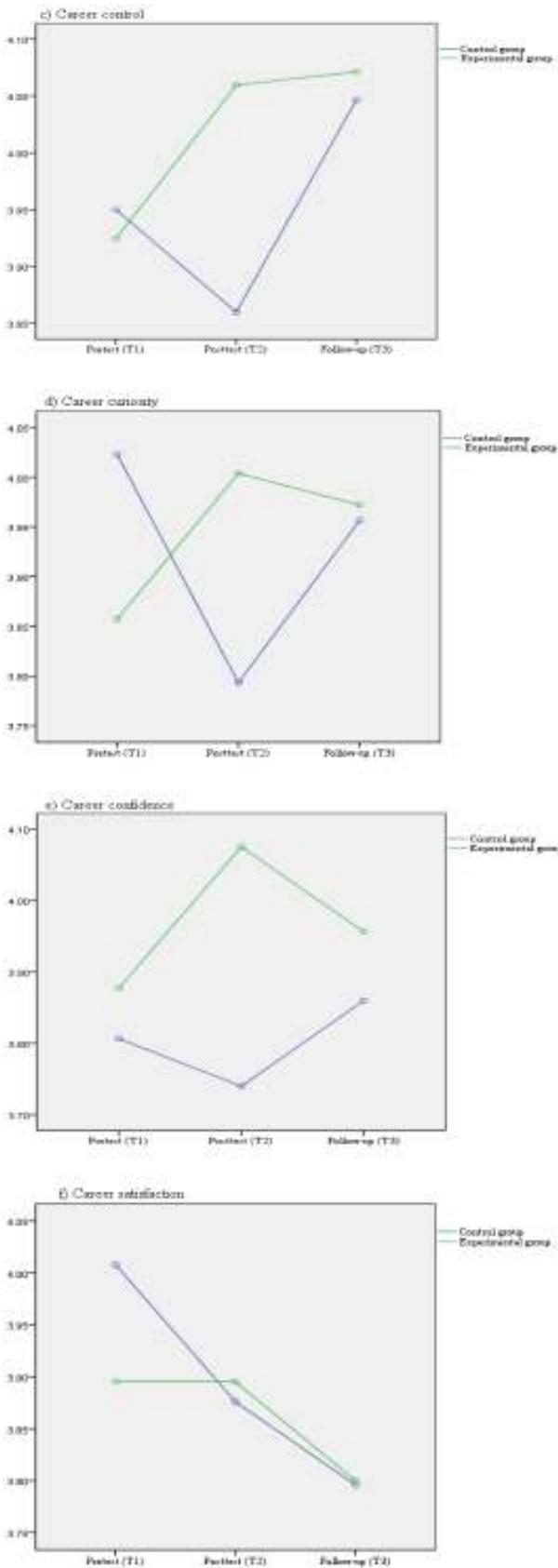


Fig. 3 Graphic representation of the dimensions of CA + cooperation at pre-training and post-training measurement for the training group

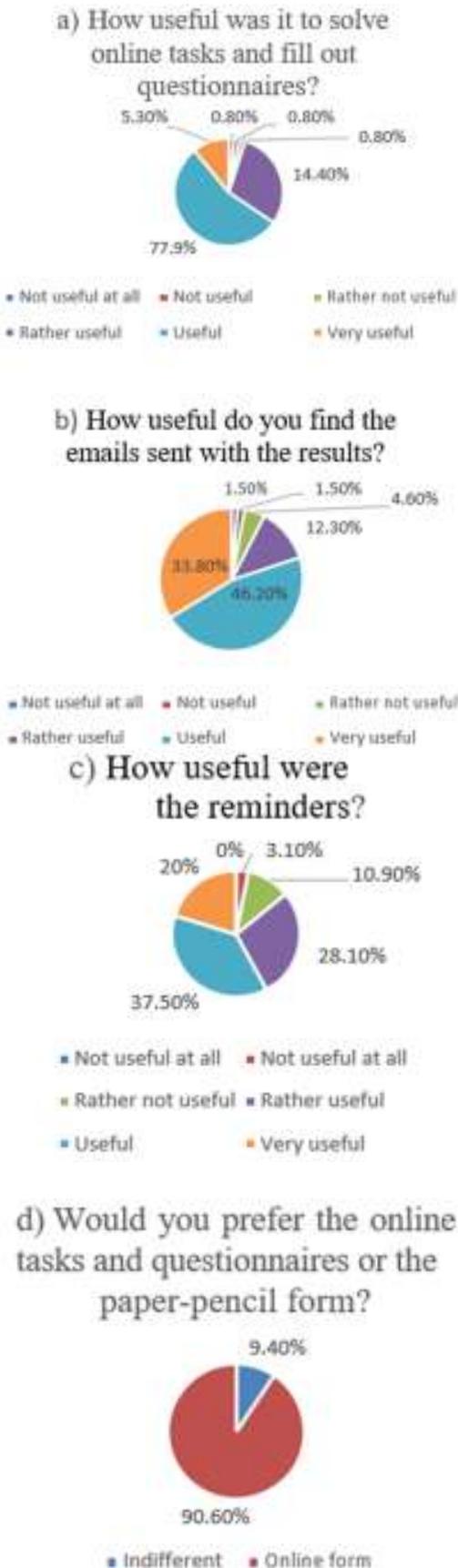


Fig. 4 Questions regarding the usefulness of the online program

#### IV. CONCLUSIONS AND DISCUSSIONS

All in all, the website karrier-labor.ro can help students who need self-knowledge in order to create a more flexible attitude towards career development and construction. In addition, clarifying their goals and values can stimulate their CA. Developing the level of CA has shown strong growth in the short term, so we recommend to students who are engaged in long-term future career development, and this program adds to their personal development.

As for the importance of CA, there is no doubt that in individuals' lives, this ability is essential for balanced and upward career development and for a satisfying life and career [25]-[29]. One of the aims of our research was to examine how this essential ability could be developed and enhanced. Similar to previous researches, this was partly successful [19]. However, more precisely, there are differences between the results, as this study has found that overall CA can be improved, including curiosity and confidence, while other researchers found that confidence did not develop [19]. Although the modality of intervention is different here, this is one of the studies where follow-up is also included in the research. In another study, which also involved computer-intervention, three scales of CA (concern, control, confidence) were managed to be improved, but these were only post-intervention measurements [30]. In contrast, this paper's results show that just after the intervention, only the subscale of concern did not increase, whereas the rest did (control, curiosity, confidence).

Despite the fact that computer-based career interventions are less effective than traditional face-to-face career guidance [2], using contemporary digital technology in career interventions offers the possibilities for better engaging youth in developing their careers [10]. Last but not least, it may be more cost-effective in the long run.

What is still very important is user experience. Many programs attempted to reach students through computer programs in the field of career development and examine this from the students' point of view, i.e., the degree to which they are satisfied with these programs [3], [4]. All this is important because designing an online interface requires a lot of testing to be operational and sustainable in the long term.

Concerning the perceived effectiveness of the program, it is clear that students favor the online form of intervention. This result encourages career counselors to invest in online programs (software). These online programs can be useful on their own or even help or just facilitate traditional career counseling. As far as satisfaction is concerned, users reported that it was helpful to share results via email and the reminders were also useful.

Even the relatively low drop-out rate proves the success of the program. In [8], which was also a 4-week online intervention and examined its effectiveness, the drop-out rate was 80%, whereas in the current study, the drop-out rate was only 30.31%. This low drop-out rate can be explained not only by the popularity of online interfaces but the frequent email reminders may also have contributed.

Overall, this study has succeeded in creating a platform that can provide a good starting point for young people who want to

improve their CA and develop their future careers. The fact is that the program alone does not provide the same level of career counseling as the traditional one, but it can more easily attract and launch the aspirations of career building in uncertain young people.

## V. LIMITATIONS AND FURTHER DEVELOPMENTS

One limitation was that the experimental and control groups were chosen arbitrarily, were not randomized, so the research followed a quasi-experimental design. In the following, it would be worthwhile to include students from other faculties to get the chance to examine whether the chosen faculty influences the extent of CA development. In addition, as technology and advisory elements evolve, it is important to make the program more appealing, spectacular and interactive, thus increasing its future effectiveness.

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# Using Google Scholar to Evaluate the Tourism Sustainability in Indonesia National Park

Rhama Bhayu

**Abstract**— Indonesia's National parks are mostly managed to limit human contact and prioritize conservation interests. The presence of the concept of sustainable tourism for people is expected to be one of the uses for national park areas in Indonesia and provide solutions for the interests of local communities and conservation groups. This research provides a comprehensive picture of the development and capability of Indonesia's national parks in accepting ecotourism activities. The meta-analysis technique is aimed at articles using the Google Scholar search engine with the keywords "sustainable tourism" + "name of the national park", in 54 national parks in Indonesia. The results showed that there were 47 works of literature on sustainable tourism studies in 23 national parks. The literature indicates that tourism in Indonesia's national parks is currently not showing a sustainable situation. However, there are still eight literature on national parks from 2015-2020 that show a positive direction towards sustainable tourism through ecotourism activities.

**Keywords**— ecotourism, google, indonesia national park, sustainable tourism.

# Value Co-creation as a Multi-Actor Perspective: The Case of Brescia Museums Foundation

Camilla Marini, Deborah Agostino

**Abstract**— Cultural institutions are places that preserve and promote collective historical memories. They have always established a strong bond with society through their patrimony. However, nowadays, their collection is not enough to keep them connected with their stakeholders. The cultural experience is growingly becoming a conversational, interactive encounter among a heterogeneous system of actors. Accordingly, cultural institutions have been required to become even more inclusive and flexible, shifting from traditional curatorial models toward more open-access, interactive and plural approaches.

In this context, collaborative practices have been gaining a renewed interest for both scholars and practitioners; among them, value co-creation is gaining relevance. Nonetheless, most of the studies investigate value co-creation practices in cultural institutions, focusing on visitors, neglecting a multi-actor perspective. Also, there are few academic contributions that address the evaluation of the value co-creation process in cultural institutions.

The objective of the study is to define the qualitative dimensions of the value co-creation process in cultural institutions. The research question focuses on how to qualify value co-creation processes in cultural institutions from a multi-actor perspective. The study adopts a single case study methodology. The methodological choice is grounded in the interest of investigating the possibility of analyzing the value co-creation process in a longitudinal project. The research is based on a three-year project with Brescia Museums' Foundation. It is a peculiar cultural institution that includes three museums, an art gallery, an archeologic park, and a historic cinema, in the city of Brescia, in the North of Italy. Due to administrative changes, the Foundation had a strong interest in detecting its ability to co-creating value with its stakeholders (i.e., other institutions, companies, but also citizens and visitors). Within this context, the research tackles the academic concern as well as the practitioner problem about how to qualify the ability of co-creating value. Moreover, the recent COVID-19 pandemic played a significant role, accelerating the interest in acquiring new collaborative managerial models that adopt a multi-actor perspective. This shift deepened the awareness of the relational potentials for cultural institutions to be in contact with their stakeholders.

Direct data sources comprise 20 interviews that involved Brescia Museums' Foundation's stakeholders and the director. Secondary data sources have also been used, such as annual reports, strategic reports, and online sources. All the materials have been analyzed through In Vivo coding, applying an inductive approach, searching for qualitative dimensions of the value co-creation process.

Preliminary results confirm the central role of interaction in value co-creation processes, and two qualitative dimensions emerge the synergy in interaction and the space of interaction. This study contributes to the academic literature about value co-creation, specifically referable to cultural institutions, enriching it with a multi-actor perspective. Additionally, this study provides practitioners and

policymakers with guidelines and actionable knowledge to manage and monitor their value co-creation strategy.

**Keywords**— co-creation, multi-actor, museum, value

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# Bio-Detection with Whispering Quantum Dots

Subha Jana, Thomas Pons

**Abstract**— Phenomenon like resonance energy transfer is widely utilized for many bio-detection schemes where biomolecules actively bind to optical donor and acceptor labeled antibodies to form “sandwich complexes” but the large size of these complexes limits the efficiency of energy transfer, preventing sensitive detection which leads to false outcomes of the tests. In our project, we propose to improve the efficiency of energy transfer through the use of solution-phase optical microcavities.

We have designed a novel optical donor that should be capable of performing the energy transfer efficiently over larger distances than the traditional resonance energy transfer limit. We have designed structures where colloidal fluorescent quantum dots (QDs) are precisely located inside dielectric microspheres and the fluorescence of the quantum dots is trapped inside the optical cavities via total internal reflections leading to optical resonances known as whispering gallery modes and the tuning of the experimental parameters will allow us to maximize the coupling of the fluorescence emission of QDs to the modes to achieve the best efficiency of the system. Following the fabrication of the optical donor, we have introduced highly absorbing dye nanoparticles as optical acceptors in the evanescent field of the microcavities and characterized the efficiency of the energy transfer through the optical modes. Now we are developing a technique to impart bio-specificity to the microbeads to detect biomolecules of interest with improved sensitivity and simple methodology.

**Keywords**— Quantum dots, Whispering Gallery modes, Resonance energy transfer, Bio-detection.

# Impact of Remdesivir for the Treatment of COVID-19 During the First Wave in Spain

Alejandro Soriano, Rocío Montejano, José Sanz Moreno, Juan Carlos Figueira, Santiago Grau, Robert Güerri-Fernández, Antonio Castro-Gómez, Yoana Ivanova, Álvaro Hidalgo-Vega, Almudena González-Domínguez

**Abstract**— The severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) causes a respiratory disease called coronavirus disease 2019 (COVID-19) that has become a global pandemic. Spain is one of the most affected European countries. The pandemic has caused the biggest recent health crisis, assuming an unprecedented healthcare burden for the Spanish National Health System (SNHS).

Remdesivir is the first antiviral conditionally approved for the treatment of COVID-19. It has been shown to shorten recovery time, reduce hospital stay, and decrease disease progression and mortality in patients with pneumonia who require low-flow oxygen therapy.

The aim of this retrospective study was to estimate the impact that the treatment with remdesivir could have had on the SNHS capacity during the first wave of the pandemic (January 31 to May 10, 2020), when remdesivir was not yet commercialized in Spain.

This study simulated the bed occupancy, the number of patients admitted to intensive care units (ICUs), and the number of deaths due to COVID-19, based on two scenarios: a real-life scenario (without remdesivir) and an alternative hypothetical scenario (with remdesivir). This analysis was based on the clinical results of the ACTT-1 trial in hospitalized patients with COVID-19 and pneumonia who required supplemental oxygen.

The results show that remdesivir could have improved the bed occupancy, reducing the length of stay in general wards and ICUs by 134,160 (CI: 35,760-183,640) and 52,961 (CI: 47,088-62,344) days, respectively. This is a reduction of 15.31% (CI: 4.08%-20.96%) and 23.98% (CI: 21.32%-28.22%). Remdesivir could have also avoided the admission of 2,587 patients (43.75%) to ICUs and 7,639 deaths due to COVID-19, which implies a 27.51% mortality reduction (95% CI: 14.25% - 34.07%).

In conclusion, remdesivir could have relieved the pressure on the SNHS and could have reduced the death toll, providing a better strategy for the management of COVID-19 during the first wave.

**Keywords**— bed occupancy; covid-19; icu; remdesivir; spain

# Developmental Difficulties Prevalence and Management Capacities among Children Including Genetic Disease in a North Coastal District of Andhra Pradesh, India: A Cross-sectional Study

Koteswara Rao Pagolu, Raghava Rao Tamanam

**Abstract**— The present study was aimed to find out the prevalence of DD's in Visakhapatnam, one of the north coastal districts of Andhra Pradesh, India during a span of five years. A cross-sectional investigation was held at District early intervention center (DEIC), Visakhapatnam from 2016 to 2020. To identify the pattern and trend of different DD's including seasonal variations, a retrospective analysis of the health center's inpatient database for the past 5 years was done. Male and female children aged 2 months-18 years are included in the study with the prior permission of the concerned medical officer. The screening tool developed by the Ministry of health and family welfare, India, was used for the study. Among 26,423 cases, children with birth defects are 962, 2229 with deficiencies, 7516 with diseases, and 15716 with disabilities were admitted during the study period. From birth defects, congenital deafness occurred in large numbers with 22.66%, and neural tube defect observed in a small number of cases with 0.83% during the period. From the side of deficiencies, severe acute malnutrition has mostly occurred (66.80 %) and a small number of children were affected with goiter (1.70%). Among the diseases, dental caries (67.97%) are mostly found and these cases were at peak during the years 2016 and 2019. From disabilities, children with vision impairment (20.55%) have mostly approached the center. Over the past 5 years, the admission rate of down's syndrome and congenital deafness cases showed a rising trend up to 2019 and then declined. Hearing impairment, motor delay, and learning disorder showed a steep rise and gradual decline trend, whereas severe anemia, vitamin-D deficiency, otitis media, reactive airway disease, and attention deficit hyperactivity disorder showed a declining trend. However, congenital heart diseases, dental caries, and vision impairment admission rates showed a zigzag pattern over the past 5 years. This center had inadequate diagnostic facilities related to genetic disease management. For advanced confirmation, the cases are referred to a district government hospital or private diagnostic laboratories in the city for genetic tests. Information regarding the overall burden and pattern of admissions in the health center is obtained by the review of DEIC records. Through this study, it is observed that the incidence of birth defects, as well as genetic disease burden, is high in the Visakhapatnam district. Hence there is a need for strengthening of management services for these diseases in this region.

**Keywords**— child health screening, developmental delays, district early intervention center, genetic disease management, infrastructural facility, Visakhapatnam district.

# Institutional Capacity of Health Care Institutes for Diagnosis and Management of Common Genetic Diseases-a Study from a North Coastal District of Andhra Pradesh, India

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**Abstract**— In India, genetic disease is a disregarded service element in the community health- protection system. This study aims to gauge the accessibility of services for treating genetic disorders and also to evaluate the practices on deterrence and management services in the district health system. A cross-sectional survey of selected health amenities in the government health sector was conducted from 15 primary health centers (PHC's), 4 community health centers (CHC's), 1 district government hospital (DGH) and 3 referral hospitals (RH's). From these, the existing manpower like 130 medical officers (MO's), 254 supporting staff, 409 nursing staff (NS) and 45 lab technicians (LT's) was examined. From the side of private health institutions, 25 corporate hospitals (CH's), 3 medical colleges (MC's) and 25 diagnostic laboratories (DL's) were selected for the survey and from these, 316 MO's, 995 NS and 254 LT's were also reviewed. The findings show that adequate staff was in place at more than 70% of health centers, but none of the staff have obtained any operative training on genetic disease management. The largest part of the DH's had rudimentary infrastructural and diagnostic facilities. However, the greater part of the CHC's and PHC's had inadequate diagnostic facilities related to genetic disease management. Biochemical, molecular, and cytogenetic services were not available at PHC's and CHC's. DH's, RH's, and all selected medical colleges were found to have offered the basic Biochemical genetics units during the survey. The district health care infrastructure in India has a shortage of basic services to be provided for the genetic disorder. With some policy resolutions and facility strengthening, it is possible to provide advanced services for a genetic disorder in the district health system.

**Keywords**— district health system, genetic disorder, infrastructural amenities, management practices.

# Influence of Extraction Method and Processing Technologies on Physicochemical Properties of Pectin from Pumpkin by-Products

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**Keywords**— By-products, degree of esterification, pectin, pumpkin.

**Abstract**—Pumpkin (*Cucurbita spp.*) by-products – are promising sources of pectin, which can be further used in food, cosmetics and non-food industries as thickener and gelling agent, as well as sources of antioxidants. The aim of research was to elaborate the most effective and environmentally friendly methods for utilizing peel and flesh of pumpkin - waste products obtained in food processing. Two types of by-products were used for extraction of pectin: a) fresh peel (crushed) and flesh obtained immediately after peeling or squeezing of juice, correspondingly; b) powders of conventionally dried peel and flesh (12 hrs drying at  $+50\pm 2^\circ\text{C}$ ). Dried materials (moisture content  $3.6\pm 0.5\%$ ) were grinded and sifted through 1.2 mm sieve. Pumpkin peel and flesh materials were extracted for 90 min at temperature  $85^\circ\text{C}$  with hot acids (HCl,  $\text{H}_2\text{SO}_4$ ,  $\text{CH}_3\text{COOH}$ ) or with hot water. Ratio of pumpkin by-products to distilled water was 1:6 (w/v); in case of acidic extraction two different pH values were examined:  $1.50\pm 0.02$  and  $2.00\pm 0.02$ . Centrifugation (*Sigma 4-16KS*) of extracts at 7000 rpm for 20 min was used to separate precipitates. Obtained aqueous solutions were mixed with 1.5-fold volume of 96%  $\text{C}_2\text{H}_5\text{OH}$  and precipitated at  $4^\circ\text{C}$  for 18 h. Separation of pectin was performed by centrifugation at 7000 rpm for 20 min. Obtained precipitates were washed twice with 70%  $\text{C}_2\text{H}_5\text{OH}$ , moistened with a small amount of distilled water and freeze-dried in laboratory freeze dryer (*Virtis SP Scientific Sentry 2.0*). Pectin content (PC) calculated on a dry matter (DM) basis reached 1.6-5.4% in pumpkin peel samples and 2.0-6.35% in flesh samples depending from the type of material and extraction conditions. In case of acidic extraction PC increased at lower pH value, but PC was not influenced significantly ( $p>0.05$ ) depending on the acid used. Extraction with hot water gave 1.9% PC in peel and 2.6% PC in flesh. High-methoxylated pectin (degree of esterification (DE)  $> 50\%$ ) was isolated from both pumpkin by-products: DE of peel pectin was 75-80% (the highest DE was reached using HCl for the extraction), but DE of flesh pectin was 75-90%. These results demonstrate that extraction with hot water can be effectively used as environmentally friendly method for isolation of high-methoxylated pectin from peel and flesh, obtained as by-products in pumpkin processing.

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# Social Distancing as a Population Game in Networked Social Environments

Zhijun Wu

**Abstract**—While social living is considered to be an indispensable part of human life in today's ever-connected world, social distancing has recently received much public attention on its importance since the outbreak of the coronavirus pandemic. In fact, social distancing has long been practiced in nature among solitary species and has been taken by humans as an effective way of stopping or slowing down the spread of infectious diseases. A social distancing problem is considered for how a population, when in the world with a network of social sites, decides to visit or stay at some sites while avoiding or closing down some others so that the social contacts across the network can be minimized. The problem is modeled as a population game, where every individual tries to find some network sites to visit or stay so that he/she can minimize all his/her social contacts. In the end, an optimal strategy can be found for everyone when the game reaches an equilibrium. The paper shows that a large class of equilibrium strategies can be obtained by selecting a set of social sites that forms a so-called maximal  $r$ -regular subnetwork. The latter includes many well-studied network types, which are easy to identify or construct and can be completely disconnected (with  $r = 0$ ) for the most-strict isolation or allow certain degrees of connectivity (with  $r > 0$ ) for more flexible distancing. The equilibrium conditions of these strategies are derived. Their rigidity and flexibility are analyzed on different types of  $r$ -regular subnetworks. It is proved that the strategies supported by maximal  $0$ -regular subnetworks are strictly rigid, while those by general maximal  $r$ -regular subnetworks with  $r > 0$  are flexible, though some can be weakly rigid. The proposed model can also be extended to weighted networks when different contact values are assigned to different network sites.

**Keywords**—Social distancing, mitigation of spread of epidemics, population games, networked social environments

# A Comparative Analysis of Geometric and Exponential Laws in Modelling the Distribution of the Duration of Daily Precipitation

Mounia El Hafyani, Khalid El Himdi

**Abstract**—Precipitation is one of the key variables in water resources planning. The importance of modeling wet and dry durations is a crucial pointer in engineering hydrology. The objective of this study is to model and analyze the distribution of wet and dry durations. For this purpose, the daily rainfall data from 1967 to 2017 of the Moroccan city of Kenitra's station are used. Three models are implemented for the distribution of wet and dry durations, namely the first order Markov chain, the second order Markov chain and the truncated negative binomial law. The adherence of the data to the proposed models is evaluated using Chi-square and Kolmogorov-Smirnov tests. The Akaike information criterion is applied to assess the most effective model distribution. We go further and study the law of the number of wet and dry days among  $k$  consecutive days. The calculation of this law is done through an algorithm that we have implemented based on conditional laws. We complete our work by comparing the observed moments of the numbers of wet/dry days among  $k$  consecutive days, to the calculated moment of the three estimated models. The study shows the effectiveness of our approach in modeling wet and dry durations of daily precipitation.

**Keywords**— Markov chain, rainfall, truncated negative binomial law, wet and dry durations.

# What Do You Mean When You Say Sustainability? Returning to Practice with Fourth Generation Evaluation to Conceptualize Sustainability in Sport for Development and Social Change

Alex Richmond, Evelyne De Leeuw, Anne Bunde-Birouste

**Abstract**— Before we implement social enterprises, it is key to understanding what these enterprises aim to contribute: sustainability. This is particularly an important concept for fields just starting to consider social enterprise to deliver their missions more efficiently. This paper returns to practice and considers this within the unique, global case of community-based organizations known as Sport for Development and Social Change (S4SC). Conceptualizations of ‘sustainability’ are diverse and sometimes incoherent. In particular, in community-based organisations it is a challenge when funders, policy makers, industry and community may not share the same conceptualization. For example, community organization operators and researchers may use the word but miss its rhetorical resonance. This leads to potential differences in understanding the needs, barriers and opportunities available to community-based organizations to reach their sustainability options. Rather than imposing assumptions regarding organizational sustainability options, barriers and facilitators, this study asks the field of S4SC what sustainability means because they are experts on the topic. When an organization, rather than a top-down institution, uses the term sustainability, what are they really saying? Fourth Generation Evaluation (4GE), a methodology which puts the study end-user at the core of the investigation, is used to frame this study. We document the process to interpret a conceptual framework for sustainability following insights gained from interaction with the study end-users. We identify the applicability and usability of this conceptualization and a framework to better understand the parameters, facilitators and barriers to the sustainability options of community-based organizations. This paper evidences the interplay of the essential conditions community-based organizations needed to empower their communities and enable the right conditions for the social mission to sustain it.

**Keywords**— Fourth Generation Evaluation, Sustainability, Social Enterprise, Sport for Development and Social Change.