

ESTIMATION OF VARIABLES AFFECTING PARAMETRIC AMPLIFICATION IN FIBER OPTICS

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Parametric processes are a separate class of optical nonlinear phenomena where optical fibre (OF) play a passive role except for mediating interaction among optical waves. These processes only involve modulation of a medium parameter such as the fibre refractive index [1].

Four-wave mixing (FWM) is referred to as a parametric process and one of useful applications is using it for optical signal amplification. One of advantages of fiber optics parametric amplifiers (FOPAs) over broadly used conventional EDFAs (erbium doped fiber amplifiers) is the ability to tune the amplification wavelength region of FOPA which is not possible with EDFA, whose gain bandwidth is limited between 1530 and 1565 nm [2]. This feature of FOPAs makes it possible to utilize them for light amplification in S (1460 to 1530 nm) and L (1565 to 1625nm) optical bands.

However, there are also numerous limitations of FOPAs that need to be overcome to make their real-life application possible. The main problem is that the gain curve of FOPA varies considerably with different parameters of optical fibers, like zero-dispersion wavelength, polarization mode dispersion and temperature. The gain curve also depends on the pump laser power and wavelength and the type and length of the optical fiber utilized to realize the process of parametric amplification.

To find out correlations between different parameter change and influence to overall FOPA performance we developed an 8 channel wavelength division multiplexing (WDM) optical transmission system using RSoft OptSim 5.2 computer simulation software. Afterward this WDM system was used to find out FOPA performance depending on the pump power, channel separation interval, fiber dispersion and nonlinear coefficient. First of all it was found that relevant limiting factor for FOPA is dispersion. To utilize FOPA it is necessary to choose optical wavelength that coincides with fiber dispersion minimum. Then it is necessary to determine the acceptable boundaries for optical fiber length and the pump power for each type of FOPA. Accurate filtering must be done as well to avoid unequal system channel amplification. Therefore FOPA performance is very sensitive towards such characteristics of WDM

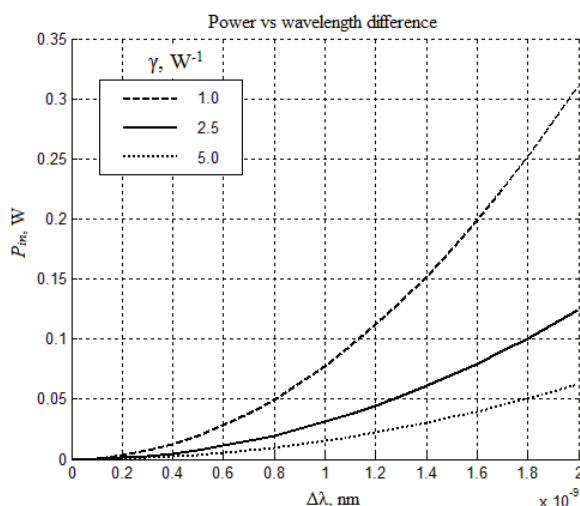


Fig.1 Calculated input power dependence on source pump wavelength separation at three different fiber nonlinear coefficients.

systems as the number of channels, the power of each channel at the amplifier input and the necessary gain. Some of calculation results are shown in figure 1.

References

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2. Agrawal G. P. Nonlinear fiber optics. Third Edition – San Diego: Academic Press, 2001. - 453 p.