

Gain and Bandwidth Improvements for Distributed Raman Amplifier in UW-WDM Communication Systems

Fathy M. Mustafa *, Ashraf A. M. Khalaf **, F. A. Elgeldawy **

* *Electronics and Communications Engineering Department, Bani-suef University, Egypt*

** *Electronics and Communications Engineering Department, ElMinia University, Egypt*

fmmg80@yahoo.com, ashkhalaf@yahoo.com, f.elgeldawi@yahoo.com

Abstract—Fiber Raman amplifiers in ultra wideband wavelength division multiplexing (UW-WDM) systems have recently received much more attention because of their greatly extended bandwidth and distributed amplification with the installed fiber as gain medium. It has been shown that the bandwidth of the amplifier can be further increased and gain spectrum can be tailored by using pumping with multiple wavelengths. In this paper, the distributed multi-pumping Raman amplifier has been studied and analyzed by testing two designed model of amplifier to obtain the gain of maximum flatness and bandwidth. Also we have investigated the effects of many parameters on the gain and bandwidth of Raman amplifier such as: pumping wavelength, offset wavelength, the relative refractive index difference and the number and location of the cascaded units used in the amplifier model design. The models is analyzed where six and eight Raman pumping of special pumping power and pumping wavelengths are lunched in the forward direction where each model is analyzed by two different way. The gain is computed over the spectral optical wavelengths ($1.45\mu\text{m} \leq \lambda \text{ signal} \leq 1.65\mu\text{m}$). The differential gain of each unit of the amplifier is obtained according to the straight line-exponential model of a small maximum constant gain of 7.4×10^{-14} m/W over an optical wavelength interval of 16 nm.

Keyword—Distributed Raman amplifier, Raman gain, Raman Bandwidth, Ultra wideband-wavelength division multiplexing (UW-WDM).



Fathy M. Mustafa (B.Sc. 2003– M.Sc 2007) received the B.Sc. degree in Electronics and communications department with honors from the Faculty of Engineering, Fayoum University, Fayoum, Egypt, in 2003. He is currently working a research assistant in Electronics and communications department at Bani-suef University. He is earned the M.Sc degree in Electronics and communication engineering in 2007 from Arab Academy for Science and Technology & Maritime Transport College of Engineering and Technology, Alexandria, Egypt. He is joined the PhD program in Mina university in 2011. Her areas of interest include optical communications, optical amplifiers.



Ashraf A. M. Khalaf (B.Sc. 1989– M.Sc 1995, PhD 2000) received his B.Sc. and M.Sc. degrees in electrical engineering from ElMinia university, Egypt, in 1989 and 1994 respectively. He received his Ph.D in electrical engineering from Graduate School of NaturalScience and Technology, Kanazawa university, Japan in 2000. He is a member of IEEE since 12 years. He works at Elect.& CommEngineering Department, ElMinia University, Egypt.



F. A. El-Geldawy: He is a professor in electronics and communications Engineering Department, ElMinia University, Egypt