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Fiber Optics Optical Communications

Pulse Distortion in Single-Mode Optical Fibers: Chirped Pulses.

Farag Z. El-Halafawy, El-Sayed A. El-Badawy, Mohamed A. El-Gamal, Mostafa H. Al

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The effect of a chirped frequency from a laser source is modeled and investigated through a soliton transmission in an inhomogeneous optical fiber with W-tailored refractive index.

Send all correspondence to: Dr. Farag Z. El-Halafawy (Name), Fac. of Electronic Eng., Menouf, 2395 (Telephone number), Egy

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Pulse Distortion in Single-Mode Optical Fibers: Chirped Pulse

Farag Z.El-Halafawy, El-Sayed A.El-Badawy[x], Mohamed A.El-Gammal[xx], & Mostafa H.Aly[xx]
Fac. of Electronic Eng., Menoufia Univ., Dept. of Wire Comm Eng.

The theory of pulse distortion in single-mode optical fibers is extended to include laser sources that suffer a linear frequency sweep (chirp) during the duration of the pulse. The chirp is manifested as a variable frequency shift during the pulse. The authors in a previous work (1) have studied the soliton transmission in inhomogeneous optical fibers with W-tailored refractive index of the form

$$n(\alpha, m, \omega, r) = n(\omega)\left[1 - \alpha(r/R)^2 + m\alpha(r/R)^4\right] .$$

R is the fiber radius while α and m are controlling parameters. In this work, a similar procedure is carried out taking into consideration a chirping effect of the form $\omega = \omega_o(1 + \Phi_m \frac{t}{T})$. T is the period of the pulse and Φ_m is the chirping coefficient whichis assumed to take values in the range $\pm$ 0.02. Calculations concerning group velocity, V_g, and peak power, P_o, are carried out at both the wavelengths 1.15 and 1.30 μm for different values of α, m, R and Φ_m . Keeping α, m and R constants, it is found that as Φ_m increases, V_g decreases while P_o increases. More remarks concerning P_o are concluded: i) There exist a threshold value $\Phi_{m(th)}$ at which the transmission starts ($P_o \gtrsim 0$). $\Phi_{m(th)}$ increases sharply with R but thenafter slows down and finally approache a constant value (-0.0025) for $R \gtrsim 20\ \mu$m. ii) Curves depecting P_o versus Φ_m for radii $\gtrsim 7.5\ \mu$m intersect at a fixed point(Φ_m = -0.003) and(P_o = 0.45 W). It is concluded that for best transmission, characterized by higher V_g and lower P_o, i) the chirping coefficient Φ_m must assume a minimum value, ii) the controlling parameters α and m must be tailored with minimum and maximum values respectively.

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(1) El-Halafawy et al., OM 85, Topical conference on Basic Properties of Optical Materials, NBS, May 7-9, 1985 , MD, USA.