Fiber Optics


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.

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Pulse Distortion in Single-Mode Optical Fibers: Chirped Pulse


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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 \( n \)-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 \( \alpha \) and \( m \) are controlling parameters. In this work, a similar procedure is carried out taking into consideration a chirping effect of the form \( \omega = \omega_0 (1 + \phi_m \frac{r}{R}) \). \( T \) is the period of the pulse and \( \phi_m \) is the chirping coefficient which is assumed to take values in the range \( \pm 0.02 \). Calculations concerning group velocity, \( V_g \), and peak power, \( P_0 \), are carried out at both the wavelengths 1.15 and 1.30 \( \mu \text{m} \) for different values of \( \alpha, m, R \) and \( \phi_m \). Keeping \( \alpha, m \) and \( R \) constants, it is found that as \( \phi_m \) increases, \( V_g \) decreases while \( P_0 \) increases. More remarks concerning \( P_0 \) are concluded: i) There exist a threshold value \( \phi_m(\alpha) \) at which the transmission starts (\( P_0 \geq 0 \)). \( \phi_m(\alpha) \) increases sharply with \( R \) but thenafer slows down and finally approach a constant value (\( \approx 0.025 \)) for \( R \gg 20 \mu \text{m} \). ii) Curves depicting \( P_0 \) versus \( \phi_m \) for radii \( \geq 7.5 \mu \text{m} \) intersect at a fixed point (\( \phi_m = -0.003 \)) and (\( P_0 = 0.45 \text{ W} \)). It is concluded that for best transmission, characterized by higher \( V_g \) and lower \( P_0 \), i) the chirping coefficient \( \phi_m \) must assume a minimum value, ii) the controlling parameters \( \alpha \) and \( m \) must be tailored with minimum and maximum values respectively.

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(1) El-Halafawy et al., 02 1985, Topical conference on Basic Properties of Optical Materials, National Bureau of Standards (NBS), May 7-9, 1985, MD, USA.