Modeling of Modern Lightwave Systems:
The Mathematical Story of the Optical Fiber

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Abstract

Our society is being transformed by a so-called *Revolution in Communications*, and quite rightfully so, since we have reached a point where one can send all of the information in the Encyclopedia Britannica from New York to London in a single second! Few are aware, however, that the source of this revolution has been the *optical fiber*. In an optical fiber communication system, a large amount of information that has been encoded as light pulses is sent along fused-silica fibers, each one no thicker than a human hair. Typically, information transmission rates are on the order of 10 Gbits per second (that is 10,000,000,000 bits per second!) or higher. To see what the next step in this revolution might be, we will discuss the main difficulties associated with sending light along an optical fiber, and the possible means by which they may be overcome. In so doing, two different mathematical problems will be presented. The first will model long distance pulse propagation, where the *optical soliton* and its mathematical properties arise. The second will discuss infrared light confinement in *Bragg fibers*, where the special geometry of the fiber is essential for efficient transmission.