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Fiber Bragg Gratings (FBG) in Optical Communications

ABSTRACT - Masterthesis

Fiber Bragg Gratings have been used as waveguide devices for spectral filtering, dispersion compensation and sensing in different fields of sensors, lasers and communication systems. In the recent years, many research and development projects have focused on the study of Fiber Bragg Gratings. The focus of this works is on solving Fiber Bragg Grating problems by using a simulation program in MATLAB.

For Fiber Bragg Gratings problems, widely used theories and numerical methods such as the coupled-mode theory and the transfer matrix method will be applied in the analysis, modeling and simulation. The coupled-mode theory is a suitable tool for analysis and for obtaining quantitative information about the spectrum of a Fiber Bragg Grating. The transfer matrix can be used to solve non-uniform Fiber Bragg Gratings. Two coupled-mode equations can be obtained and simplified by using the weak waveguide approximation. The spectrum characteristics can be obtained by solving these coupled-mode equations.

The direct numerical integration method and the transfer matrix method have simulated Uniform and Chirped Fiber Bragg Gratings respectively. The reflected spectra, time delay and dispersion of Fiber Bragg Gratings depending upon different physical parameters can be obtained by using this simulation program. At the same time, the maximum reflectivity, bandwidth and center wavelength can also be obtained.

This thesis consists of three parts. The first part introduces a suitable theory and modeling that have been used to analyze the characteristics of Fiber Bragg Gratings. Secondly, the codes of the modeling are realized in MATLAB development environment. Finally, this simulation program is utilized to analyze Fiber Bragg Grating in a Graphical User Interface (GUI) environment.