Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

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Pradeep Noronha

Investigations an Optical Spectra and Coherency of Semicoductor Laserdiodes

ABSTRACT - Masterthesis

Through this master work I persued at Hochschule Bremen, University of Applied science, Bremen, Germany, I carried out research work pertaining to the study of semiconductor diode laser spectra. Experimental and theoretical investigations were done and knowledge was gained through:

1) Study of literature on the semiconductor diode laser spectra.
2) Understanding and implementation of the self-heterodyne experimental setup.
3) Investigating the effect of injection currents and temperatures on the optical spectra.
4) Observing trends like spectral re-broadening at high drive currents and the variation of line widths and peak powers with drive currents.
5) Investigations on the effect of direct modulation on the laser diode spectra.
6) Simulations in matlab for Lorentzian curve fitting, peak fitting and polynomial split spectrum fitting of the laser spectra and comparison of results.
7) Data acquisition and optimization by building Graphic User Interfaces for the simulations performed.

It is important to carry out a thorough study of the Laser's spectral characteristics, especially the line width and the line profile of longitudinally single mode DFB-Lasers because the line width and line profile are determining coherence length and coherence time of laser diodes which are important parameters in optical communications and metrology. It gives us information on the phase noise. Only estimated values of laser line widths are provide by the manufacturers and hence, accurate measurements of spectral line widths and noises are necessary. This is done using the self-heterodyne setup. Sikora GmbH, under whose guidance the experimental setup was constructed, works in the field of diameter measurements of pipes and hoses which use DFB lasers of high coherence as optical sources of light.

Operating conditions (injection current and temperature) as well as optical feedback and direct modulation are affecting laser emission and optical spectra. This needs to be experimentally and theoretically investigated.

Data acquisition of investigated optical spectra has to be optimized and data processing and friendly representation and display provided by building GUIs.

As future work, investigations on spectral re-broadening of semiconductor lasers, simulation of the self-heterodyne setup to understand modulation of the laser light and realtime data acquisition using GUIDE tool of 'matlab' is suggested.