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

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

Master 2008

Shinu Abdul Wahid

Investigation on Mach-Zehnder Interferometer structures comprising Delayed Self Heterodyning for spectral analysis of Laser diodes.

ABSTRACT - Masterthesis

Optical metrology applications in industries are rapidly expanding. Online diameter determination of wires and optical fibers using laser shadow projection is of growing importance when extremely high accuracy in sub-μm range is aimed at. The key feature is the analysis of diffraction patterns employing sophisticated signal processing.

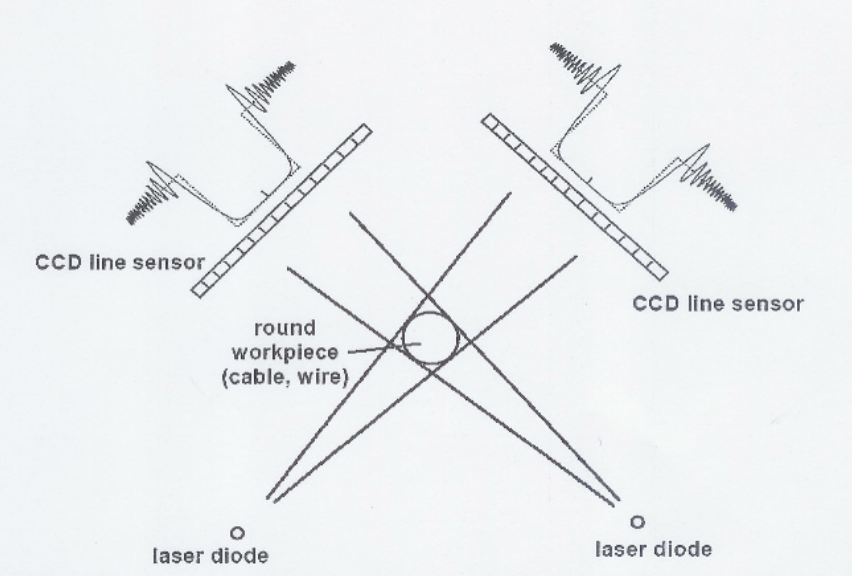

Figure 1 : Set-up of optoelectronic components in measurement head of SIKORA AG, Bremen

Within a common research project SIKORA AG and Institute of Microelectronics, Micromechanics and Microoptics (I3M), Hochschule Bremen are cooperating to investigate relevant conditions for very high accuracy in diameter determination in a measured field of 5 mm x 5 mm.

First experimental results show a strong dependency of achieved measurement accuracy on used laser diodes of various types and manufacturers. These laser diodes are different in many aspects, including their spectral emission profile.

To determine if line width is the decisive parameter to obtain the desired +/- 0.05 μm diameter measurement accuracy, a self-heterodyne setup is used to evaluate optical-spectra of DFB (Distributed Feedback) laser exhibiting a full width half

maximum of approximately 1 MHz. The optical circuit of self heterodyning is based on the Mach-Zehnder interferometer structure.

The Thesis work combines experimental parts of line width determination employing a delayed Mach-Zehnder interferometer with study of different Mach-Zehnder structures in various state of the art applications.

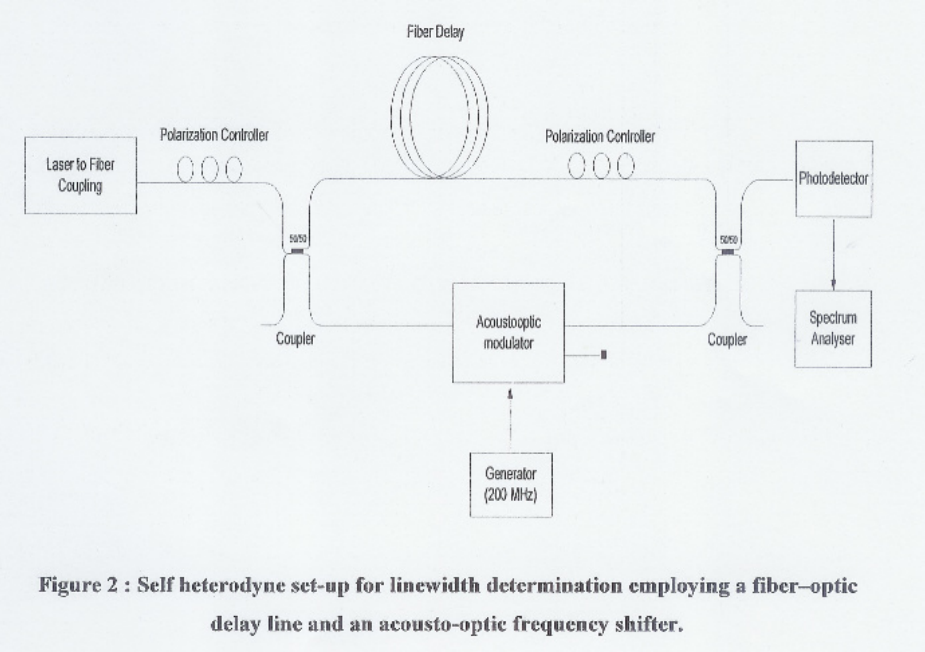

Figure 2 : Self heterodyne set-up for linewidth determination employing a fiber–optic delay line and an acousto-optic frequency shifter.

The planned work package includes;

- Investigations on state of the art Mach-Zehnder interferometer applications, including fiber-optic and integrated-optic interferometer versions are carried out.
- Implementation and optimisation of a self-heterodyne set-up for 0.85 μm laser central wavelength in near infrared area is aimed at.
- Line width determination of selected DFB-Lasers considering influence of electrical driving circuit characteristics, driving conditions of used laser diodes and optical feedback from reflections.
- Systematic analysis and documentation of experimental results and detailed comprehensive description.