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Master Degree Course Electronics Engineering, MSc EE

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Realization of a Laser-Doppler-Vibrometer.

ABSTRACT - Masterthesis

The non-contact measurement of materials, structures or parameters with laser measurement systems offers great potential for applications in the scientific and, as planned here, in the industrial sector. The advantages lie in the high precision (e.g. measurements of deflections in the nm range), the non-destructive nature of the measurement and the high measurement frequency, which is only limited by the measurement electronics. Especially with materials above 600 °C, a non-contact measurement is superior to measurements with contact.

In the steel industry, these temperatures are reached frequently. A contact-free measurement is therefore almost unavoidable. A method for non-contact material testing is based on the laser-ultrasonic method (photo acoustic effect). Ultrasonic waves are excited in the object to be examined and detected using a vibrometer. The ultrasonic frequency spectrum of the sample can be recorded with such a measuring system. As described, the method is non-contact and introduces no damping into the system.

In this work, a laser-based measurement system is developed and implemented, which quantifies the frequency of vibrations of a reflecting surface. The setup is based on interferometry. A Doppler shift is induced in a laser beam in a beam path arm using an oscillating mirror.

This is then mixed with a reference beam in a photorefractive crystal and measured with photodiodes. In the present case, the surface to be measured should be excited with a piezo crystal in the kHz range as a first approach.