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

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Master 2017

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Comparison of Different Vibration Measurement Techniques on Matallic Sheet Cantilever.

ABSTRACT - Masterthesis

Microsystem sensor devices are often based on measuring mechanical deflection or vibration of cantilever. Examples are Sensor of Atomic Force Microscopy, acceleration sensor switches, vibration sensors or chemical sensors. For modelling such systems in our student laboratory an experiment is used, were the beam deflection of long metallic sheets are detected by 4 resistance strain gauges placed on that sheet. Currently this experiment can only measure static deflection. To get a better understanding of the behavior of a cantilever it would be helpful, to extend the experiment to vibration measurements. Especially measurements of higher overtones would be interesting. Also the damping should be detected. The system should be flexible to realize different frequencies by changing the length of the metallic sheet.

For vibration measurements, different detection methods like optical reflection intensity, triangulation, optical lever, acceleration measurement or the already implemented strain gauges can be used. Object of this master thesis is the comparison of such methods in terms of ability to measure eigenfrequencies and damping of the metallic sheets. Based on the results an automated measurement system should be built up and characterized.

The master thesis includes the following tasks:

- Characterizing the capability of the current equipment in terms of sensitivity, cut off frequency and noise for dynamic measurements and investigate possible ways to optimize the detection system especially in terms of measuring higher frequencies.
- Based on the result develop a new concept of mechanical set-up with several strain gauges. It should be possible to vary the resonant frequency by changing the length of the beam. The strain gauges should be placed in such a way, that are be optimized for individually higher overtones.
- Theoretical comparison of vibration detection by different sensing techniques in terms of sensitivity, linearity and frequency range.
- Experimental verification of this comparison on at least three different techniques.
- Selecting most suitable method for the metallic sheet vibrations
- Developing an automated data recording and analyzing system for this method which calculates the eigenfrequency and damping of the cantilever.
- Find a method to calibrate the signal to the real amplitude of the vibration
- Characterizing the new system in terms of capability and accuracy
- Documentation