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Measurement of Resonance Frequency and Damping of Silicon Cantilevers.

ABSTRACT - Masterthesis

This thesis is focused in Micro system sensor devices (which are normally dependent on measuring of mechanical deflection or vibration of cantilever; for example sensor of atomic force microscopy, vibration sensor, chemical sensor and acceleration sensor switch). The main focusing of this paper is in resonant frequency and damping. The objective of this paper is to design and develop an automatic data acquisition optical set-up for measuring the resonant frequency of silicon cantilever and another task is generating vibrating excitation of cantilever.

The resonant frequency of the cantilever can be measured using optical beam deflection method. Laser diode beam incidences on the cantilever free-end and reflected beam is collected by using one dimensional position sensitive photodiode. Photodiode generates two photo currents, which are amplified by Transimpedance amplifier and converted into voltage. (D. Ramos, 2006). Next differential and summing amplifiers are used for measuring differential signal and summing signal. The position of laser light on the cantilever beam is obtained, dividing differential signal by summing signal. Next differential signal is collected by using an arduino microcontroller. The resonance frequency of the cantilever is measured through analyzing these data in MATLAB.

Data Acquisition (DAQ) is a method of measuring a form of data like temperature, pressure and converting them into another form suitable for storage. For example the temperature, fluid flow measurements made by sensors are analog in nature. This needs to be digitized so that the signal can be encoded to reduce and correct transmission errors. A DAQ system consists of sensors, DAQ measurement hardware and a computer with programming software.

For data acquisition purpose the arduino Uno microcontroller is used. The main task of microcontroller is assembling a signal acquisition system using ADC. It is easy to handle, very low cost and very good accuracy in technical purpose.

For vibration excitation purpose a small pieces of iron rod is used. It is applied to the supporting body of cantilever and cantilever vibrated. In this time vibrating signal is collected and Eigen frequency is measured.