Design and Development of Vibration-Material GMR Based-Sensor

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Outline Presentation

- Introduction
- Design of Vibration Sensor
- Calibration and Measurement
- Result and Discussion
- Research Output

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Introduction

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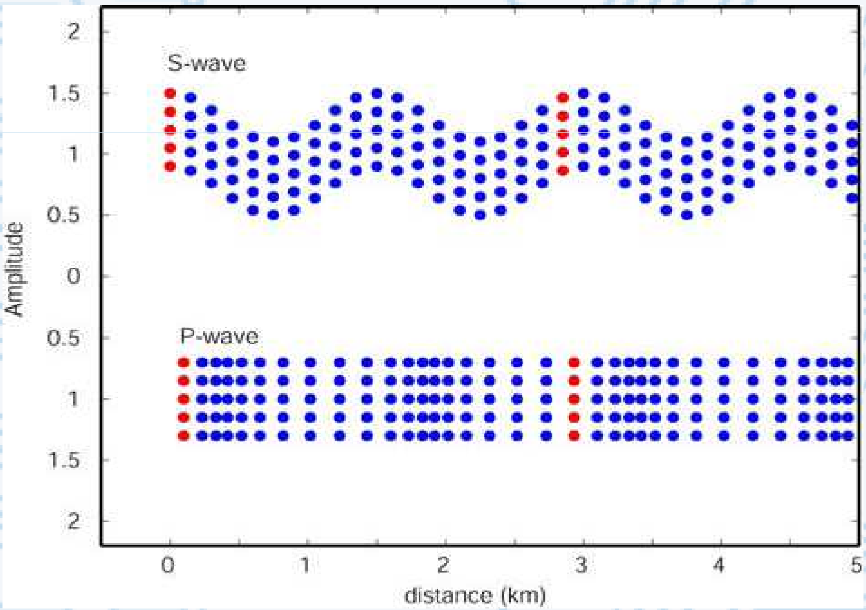
Motivation

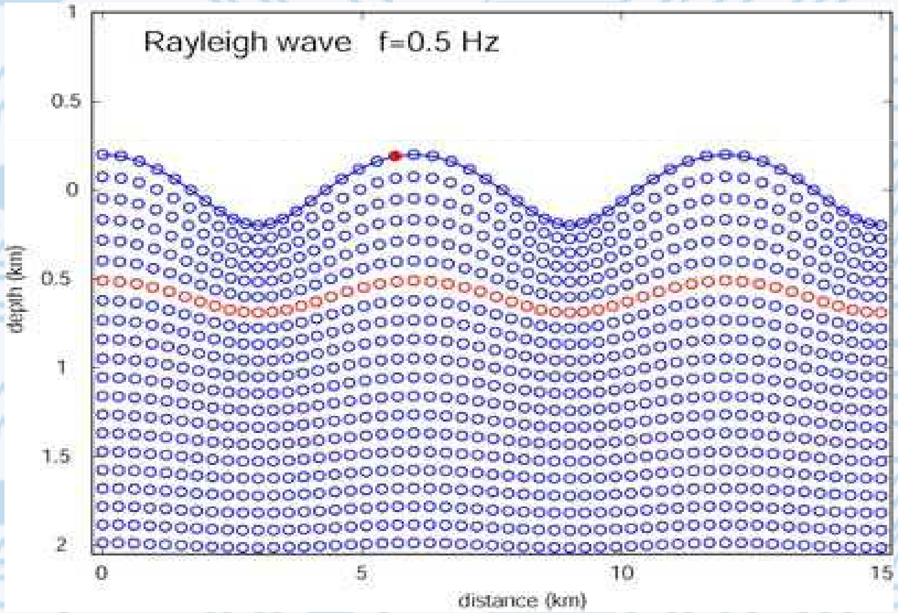
- The results of earthquake monitoring conducted by *Badan Meteoreologi dan Geofisika* which indicates that the seismic activity in Indonesia is very active.
- Vibration like an earthquake is a phenomenon of physics, where the characteristics of these vibrations can be used as an early warning system so as to reduce the loss or damage.
- GMR materials have great potential as a next generation magnetic field sensing devices, has high magnetic and electric properties so it has the potential to be developed into a variety of applications such as vibration sensors.

An earthquake is a vibration or shock that occurs on the Earth's surface caused by the release of energy from the deep so that creates seismic waves.

Seismic Waves



a. Body Wave

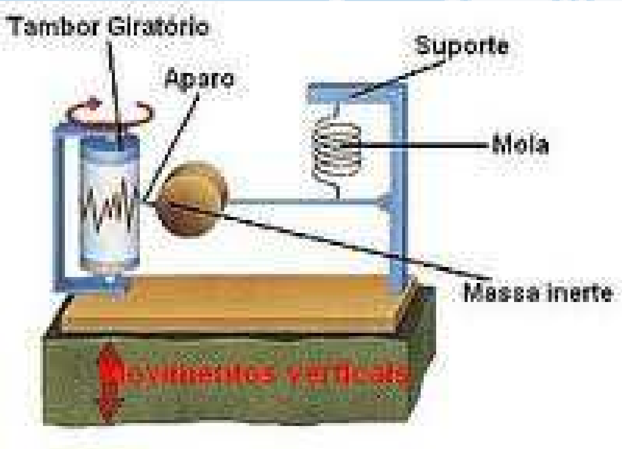


b. Surface Wave

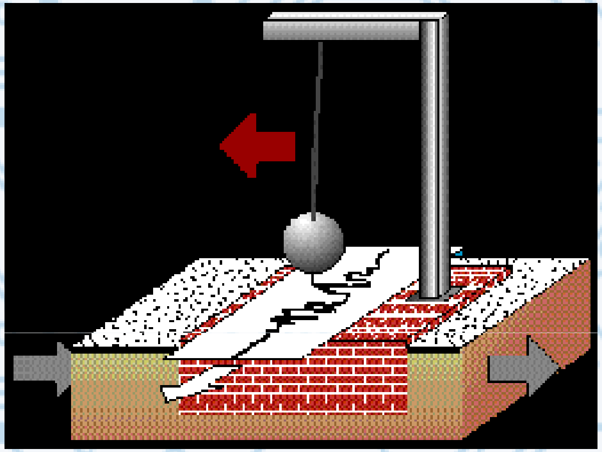
Vibration Sensor :

(a)Vertical motion; (b), (c) Horizontal Motion; (d) Vibration sensor use laser

(a)



(b)



(c)

(d)

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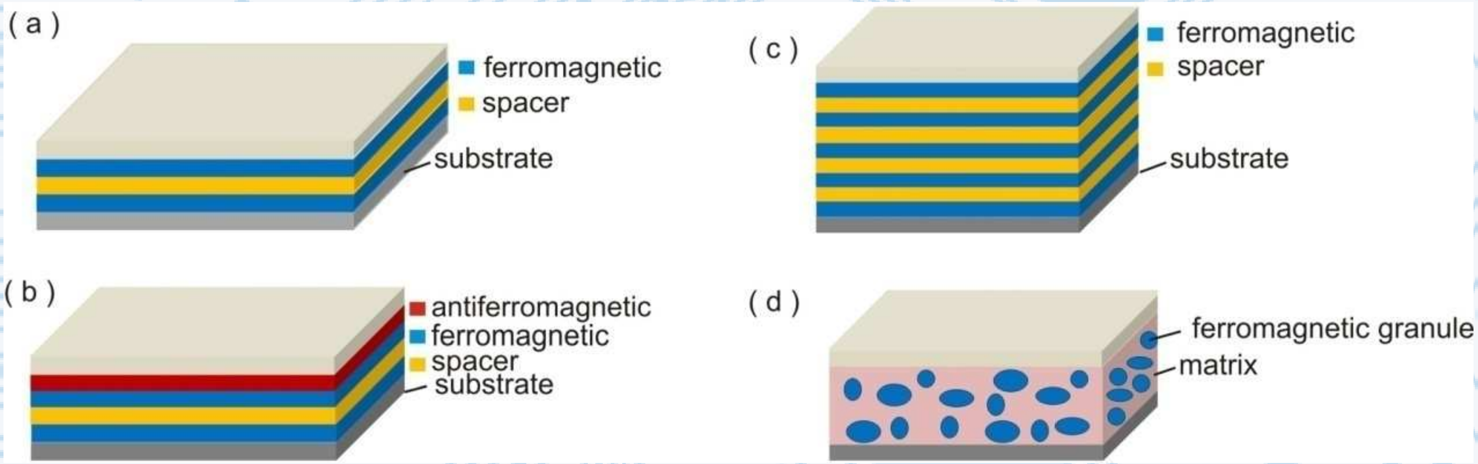
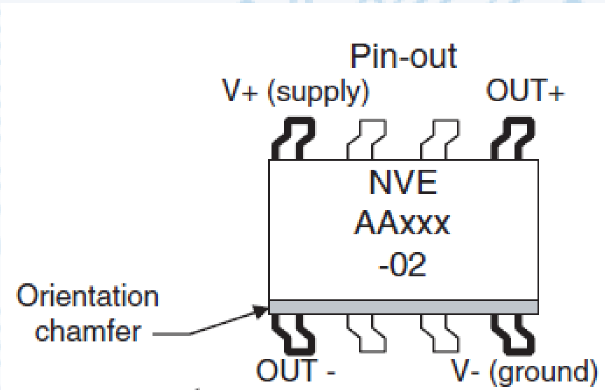
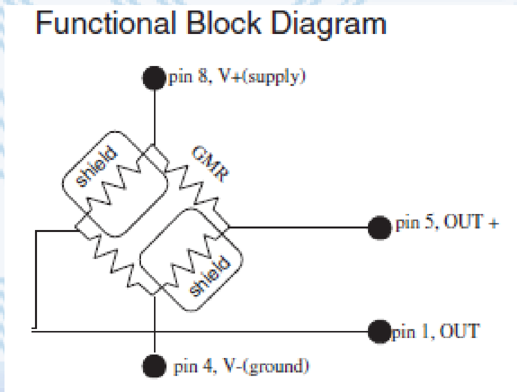
Structure of GMR material : a. Sandwich (trilayer), b. Spin Valve, c. Multilayers, d. Granular



GMR Sensor NVE with Functional Block Diagram





Design

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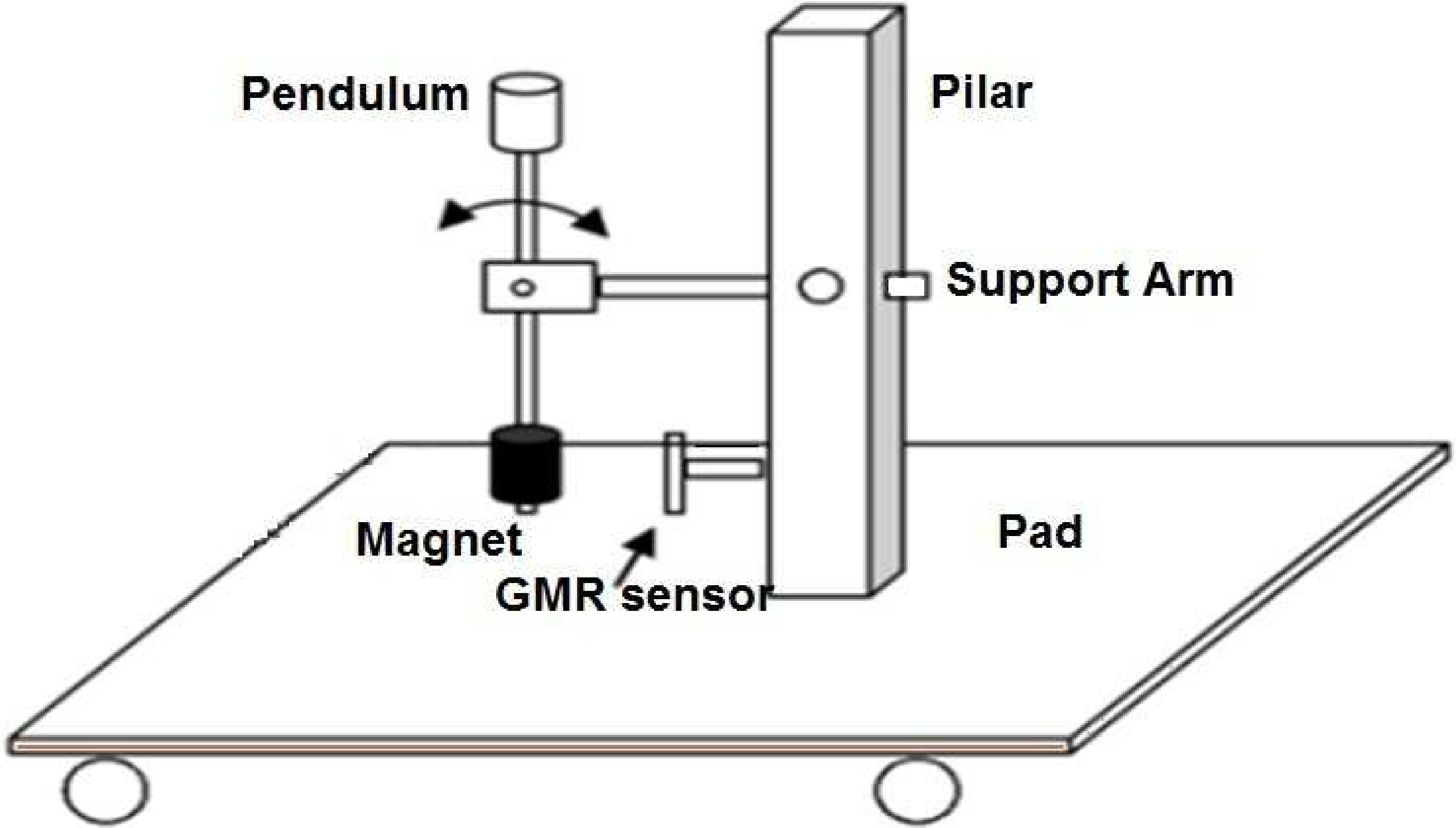
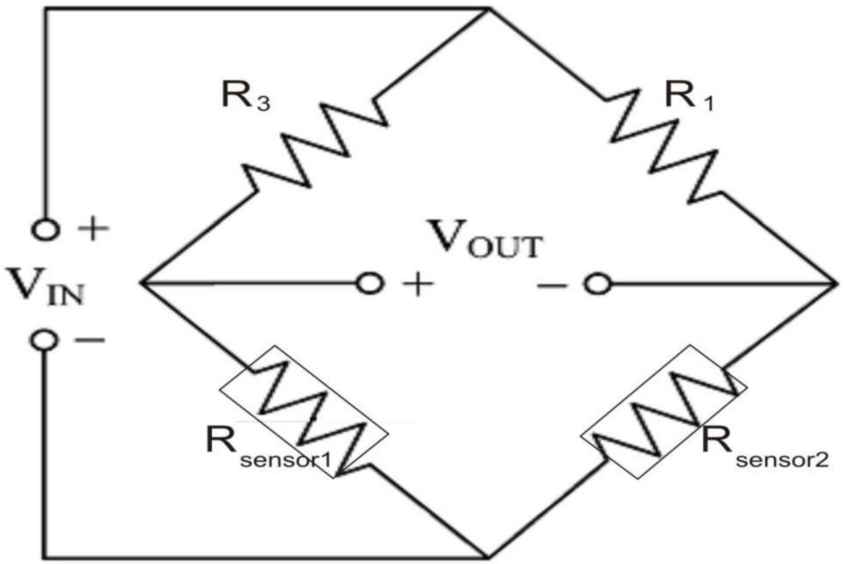
Mechanics System of Pendulum



Wheatstone bridge circuit used in the prototype sensor



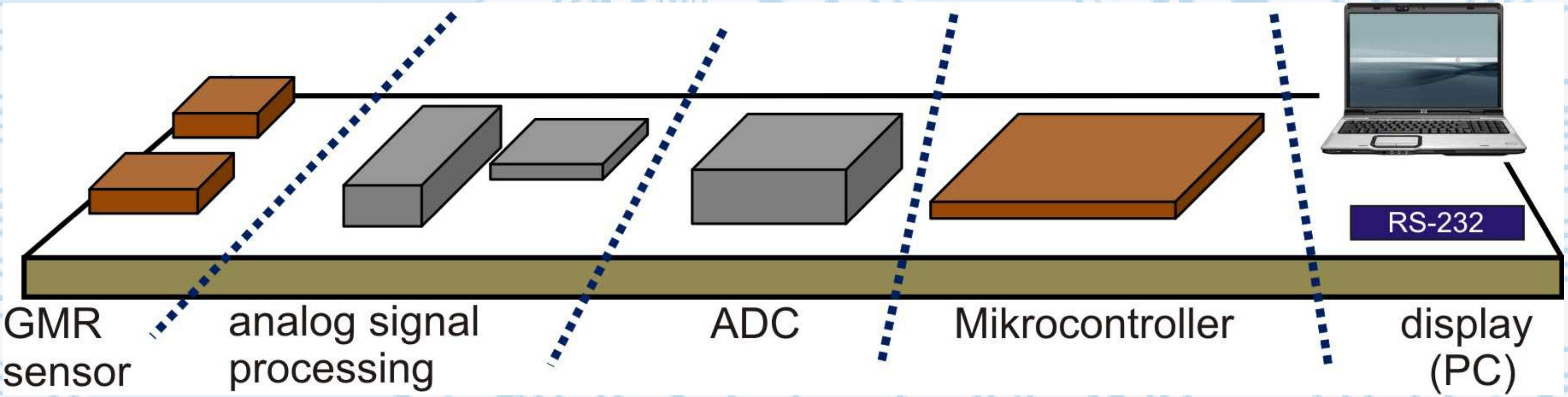
output voltage

$$V_{OUT} = \left[\frac{R_1 R_{sensor1} - R_3 R_{sensor2}}{(R_1 + R_{sensor2})(R_3 + R_{sensor1})}\right] V_{IN}$$

At equilibrium, the output voltage in equation above would be equal to zero.

When near the GMR thin film sensor is given an external magnetic field, the resistance of a GMR thin film will change, so that the output voltage will arise.

Schematic of measurement system

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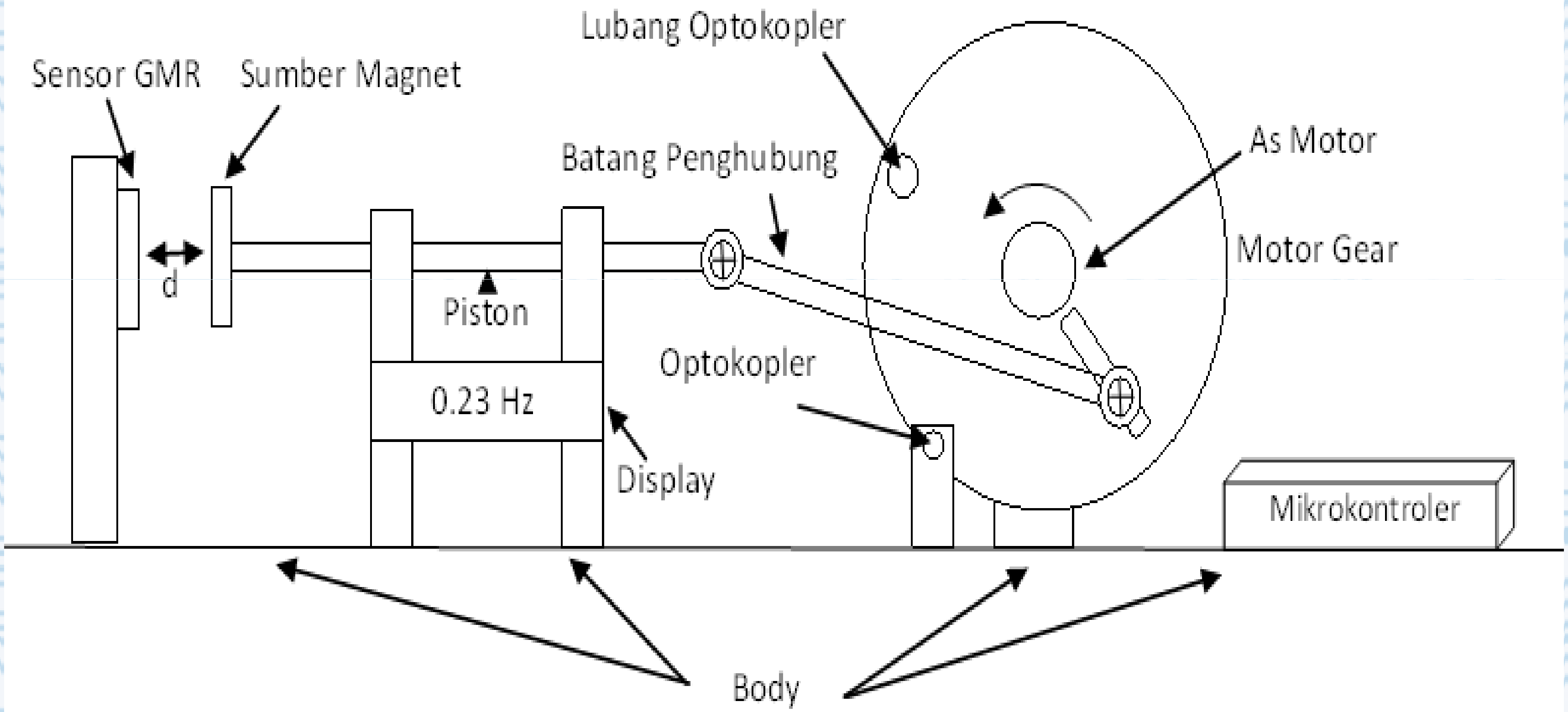
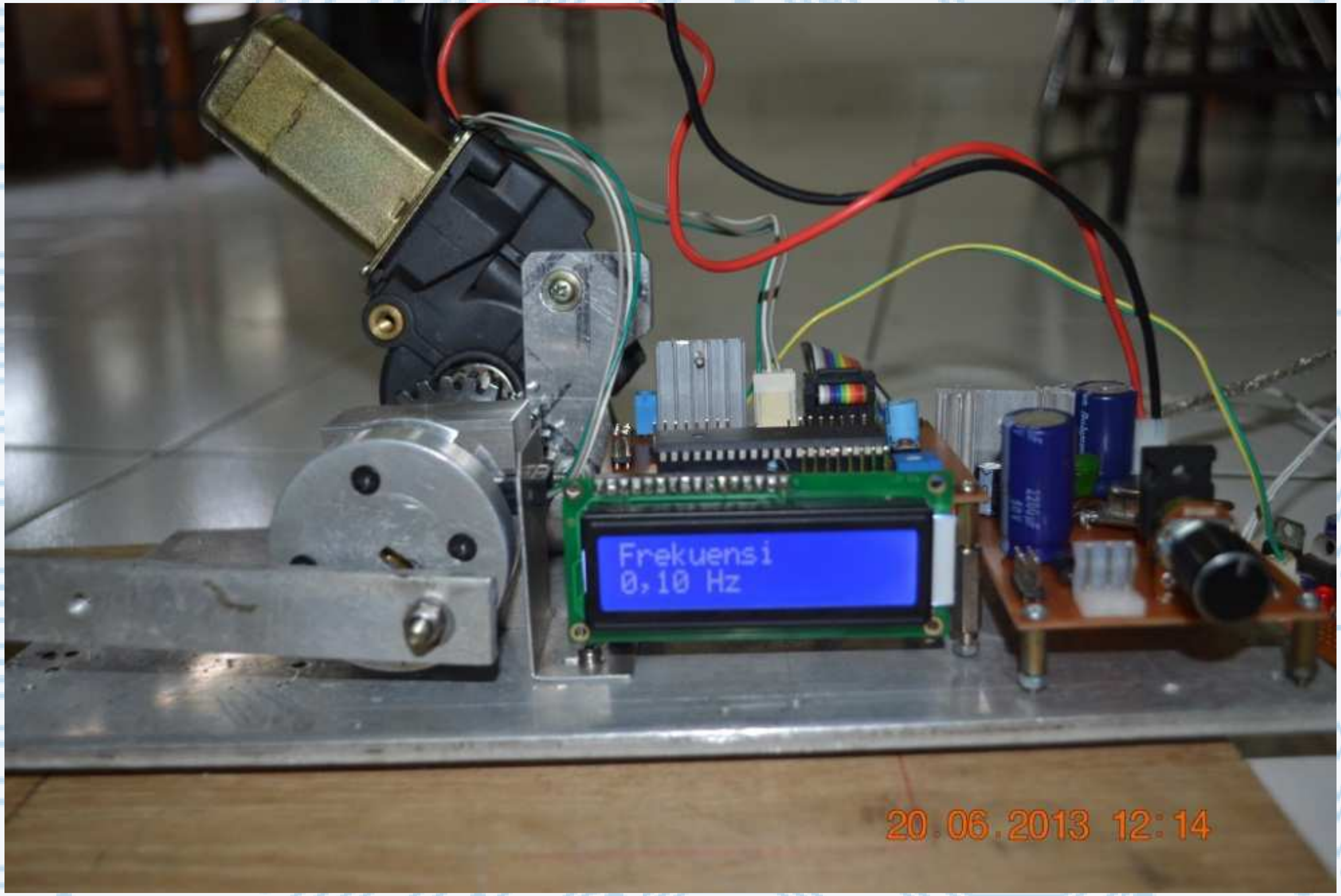
Calibration and Measurement

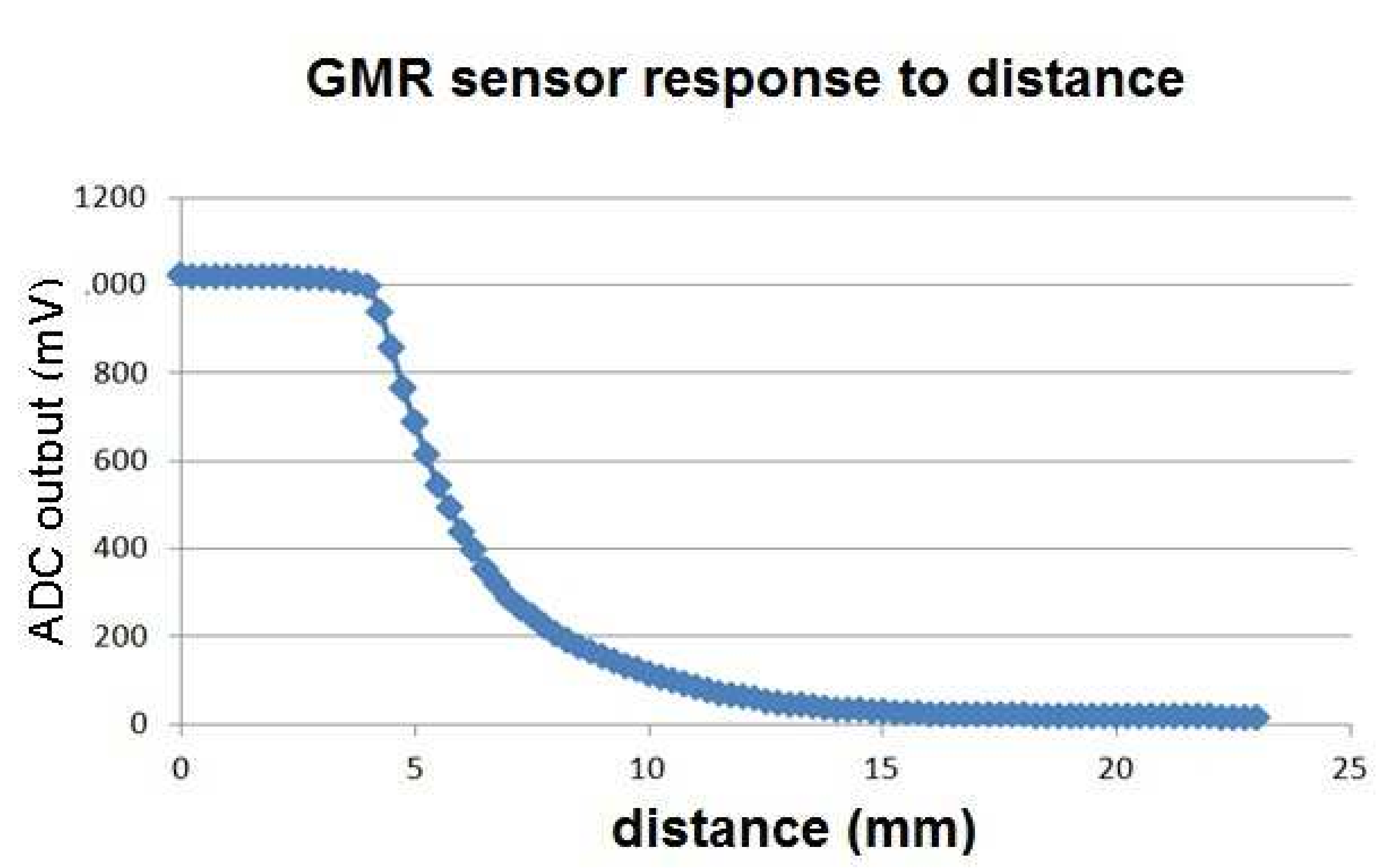
Calibrator System



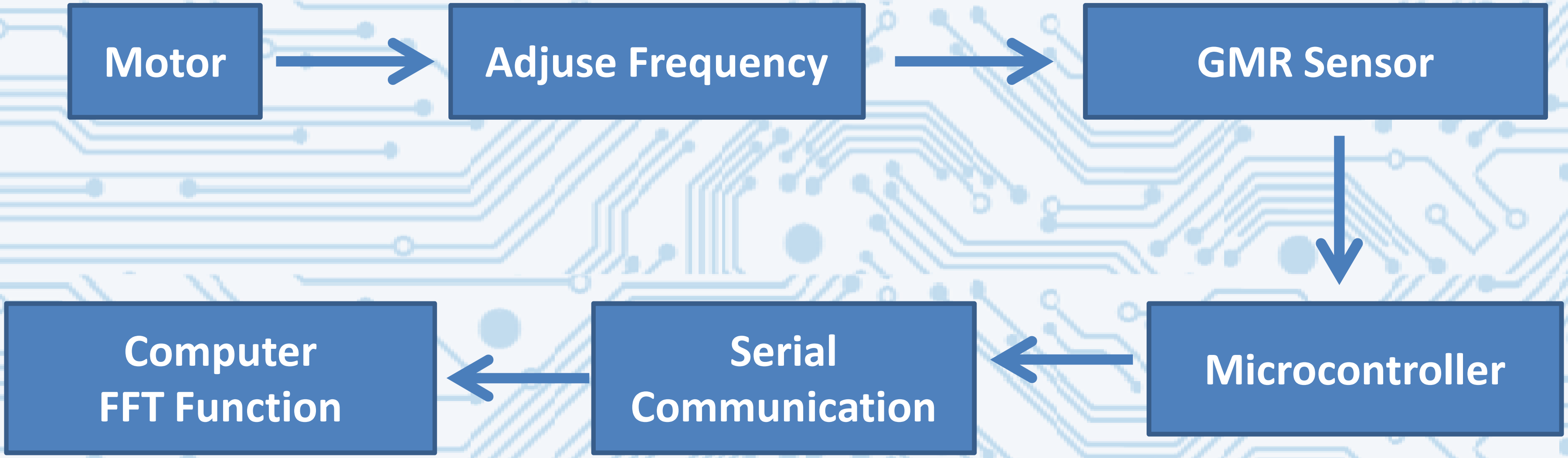
Calibrator System



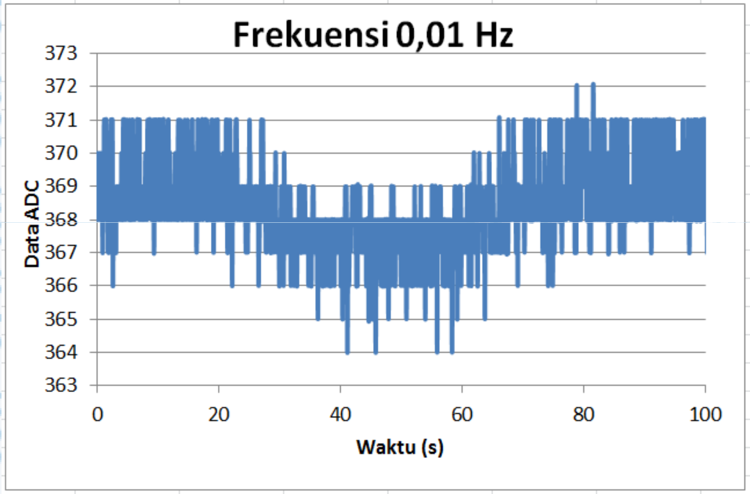
Variation of distance to GMR Sensor response

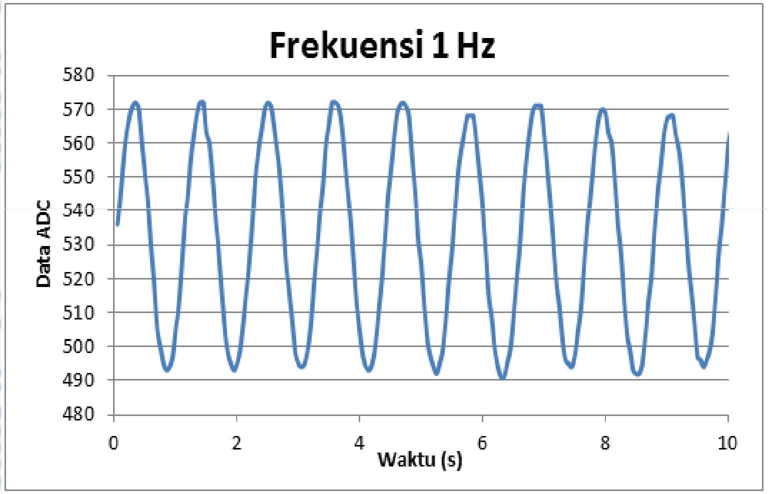


Experimental Procedure



Data of Mesurement for Frequency 0,01 Hz and 1 Hz

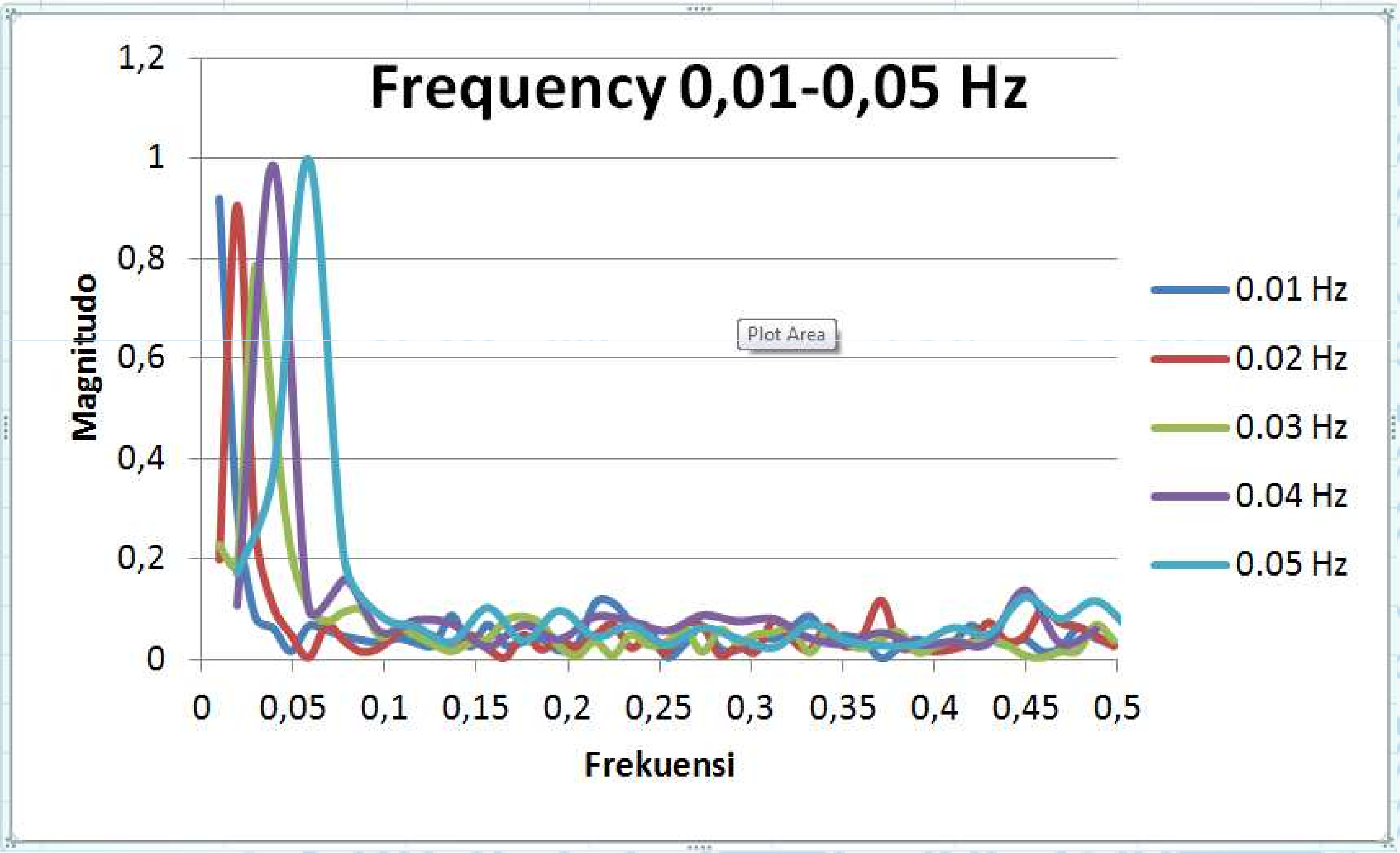




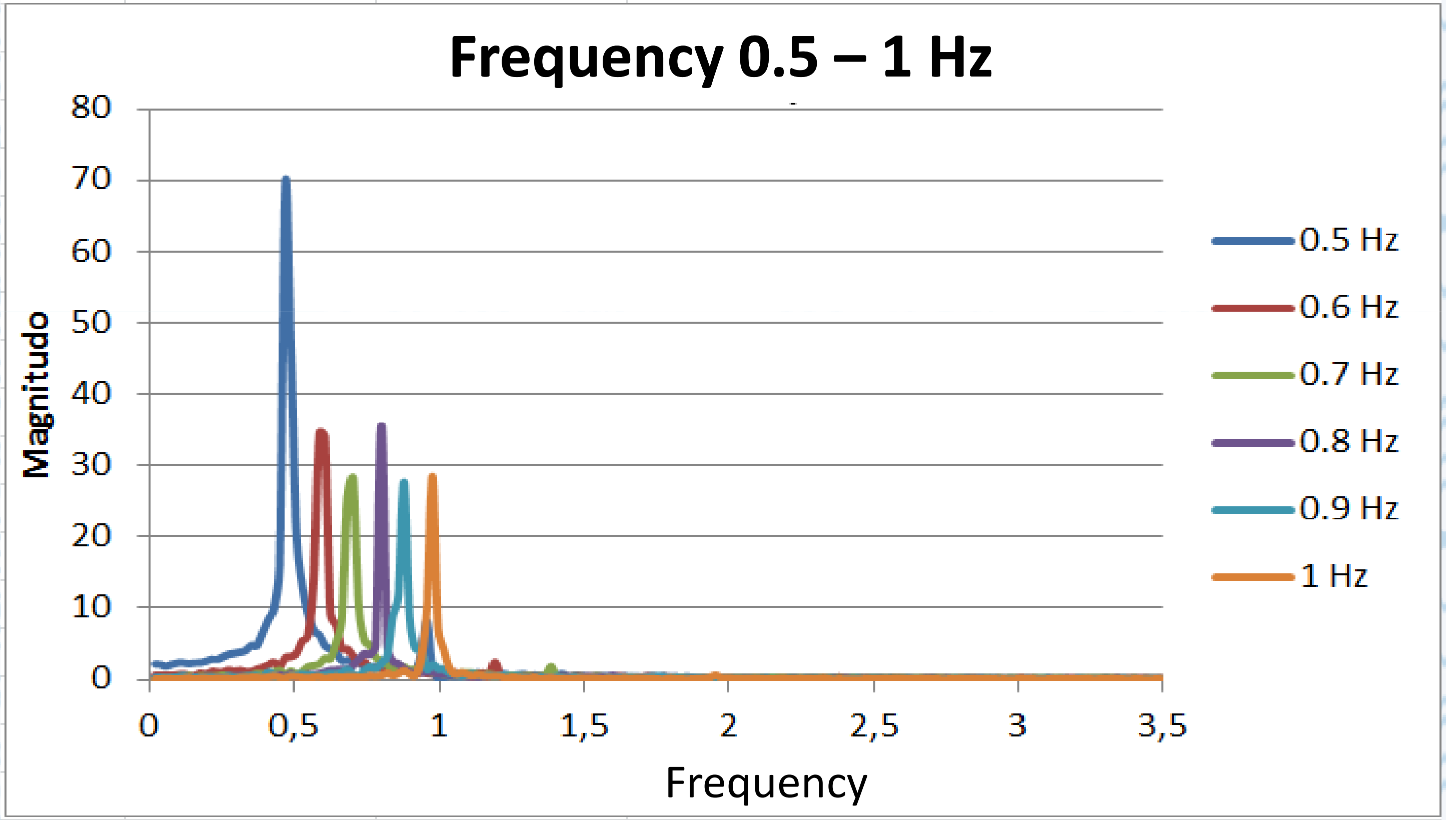
Result and Discussion

Graph of Frequency (from FFT function) :

a. Frequency 0,001 to 0,005 Hz;



b. Frequency 0,5 to1 Hz



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- Pendulum system can be use to detect vibration in low frequency
- Frequency 0,4Hz is natural frequency of pendulum, so this frequency must be avoided
- Author belive that this sensor can be use to detect eartquake very well, but development of the sensor is needed to make this sensor perfect.

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Research Output

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Journal:

Mitra Djamal, Ramli, “Thin Film of Giant Magnetoresistance (GMR) Material Prepared by Sputtering Method,” *Advanced Materials Research Vol. 770 (2013) pp 1-9.*

Conference:

Ary Prabowo, Mitra Djamal “Development of Vibration Sensor low frequency based GMR to Detect Eartquake” Seminar ISCSM, ITB, june 2013

Patent:

Alat Ukur Getaran Frekuensi Rendah Berbasis Sensor GMR (to be submitted)

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Thank You