
Seismometer Isolation for Noise Cancellation at 40m Lab

LIGO SURF 2016
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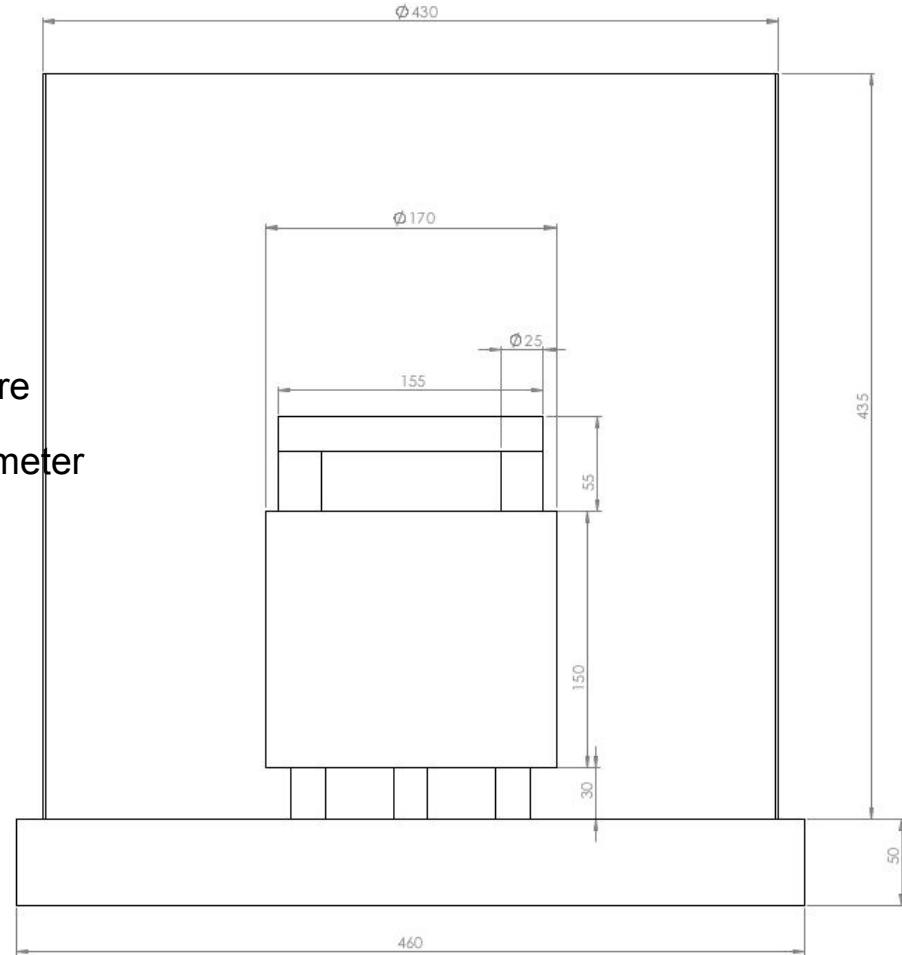
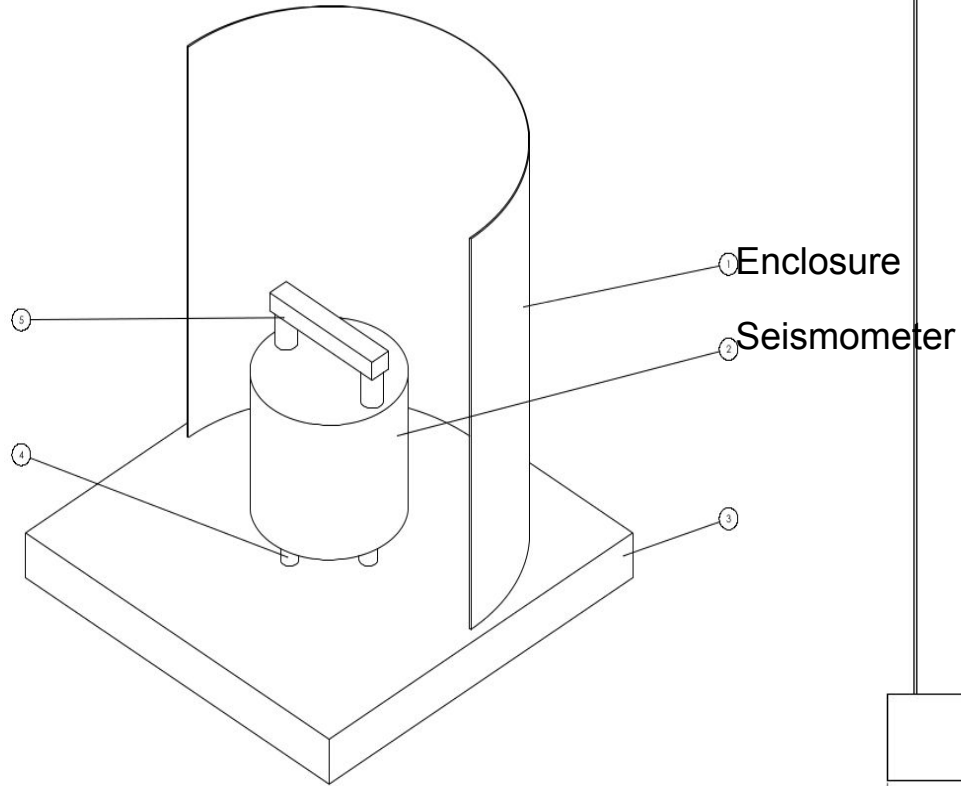
Overview

- Motivation & Objectives
- Experimental Setup
- Preliminary Results
- Future Work
- Summary

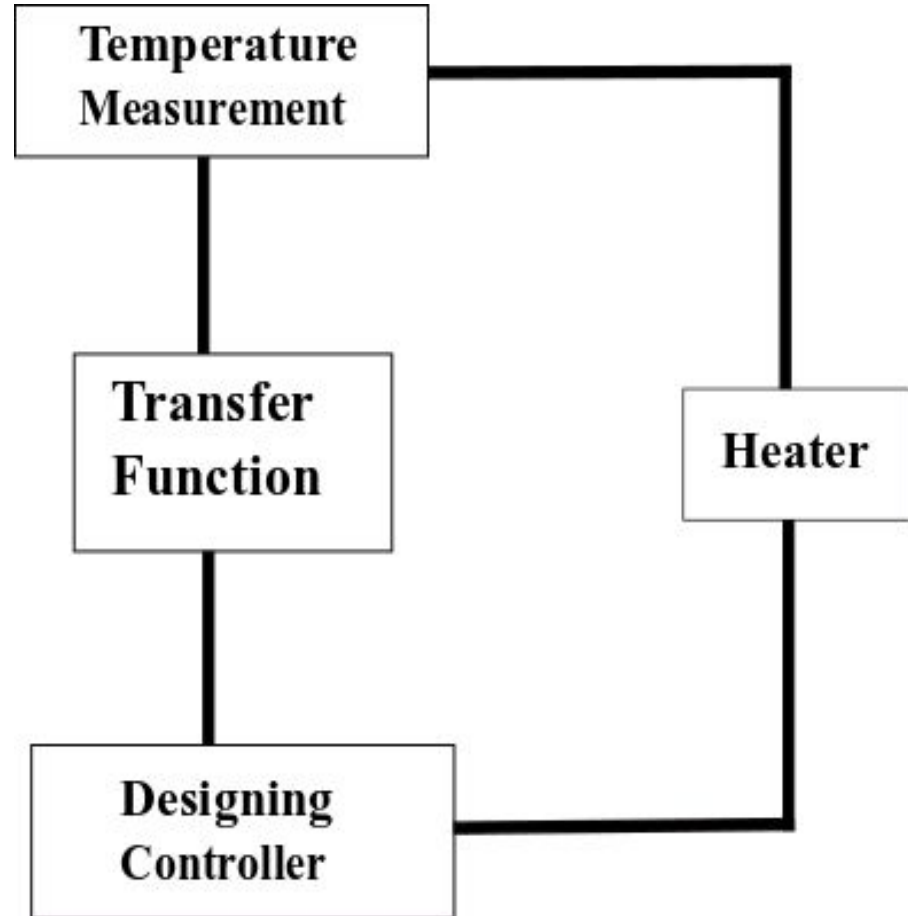
Motivation & Objectives

- To improve seismometer's sensitivity at low frequencies
- To develop enclosure for the seismometer at the LIGO 40m lab
- To protect seismometer from environmental fluctuations which include thermal and electromagnetic fluctuations.

Seismometer & Enclosure

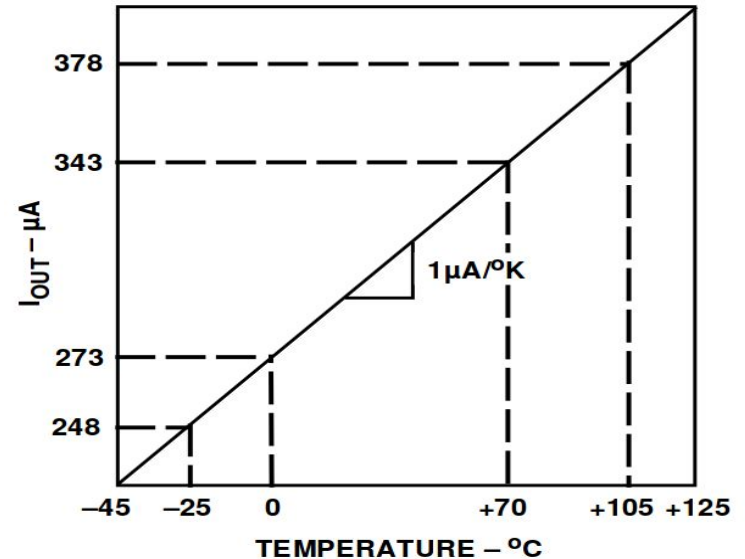
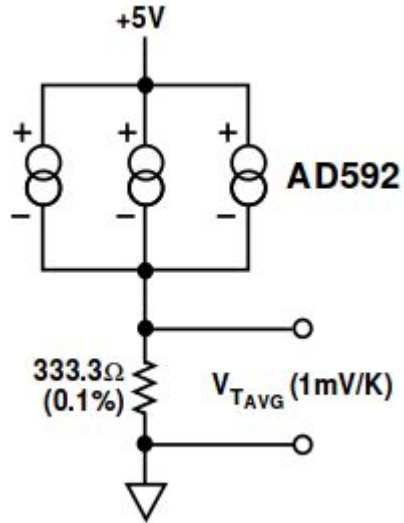


Experimental Objectives



Temperature Measurement

AD592 CZ Temperature Transducer output current \propto absolute temperature

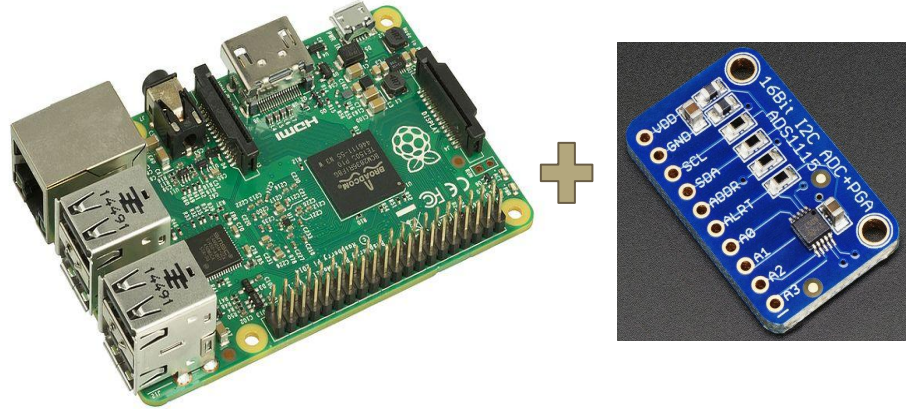


Acquiring Data

Acromag Busworks I/O Card



RPi Model B GPIO- Multipurpose



Acromag

Data I/O Future Plans at LIGO 40m

Experimental Physics and Industrial Control System by ANL

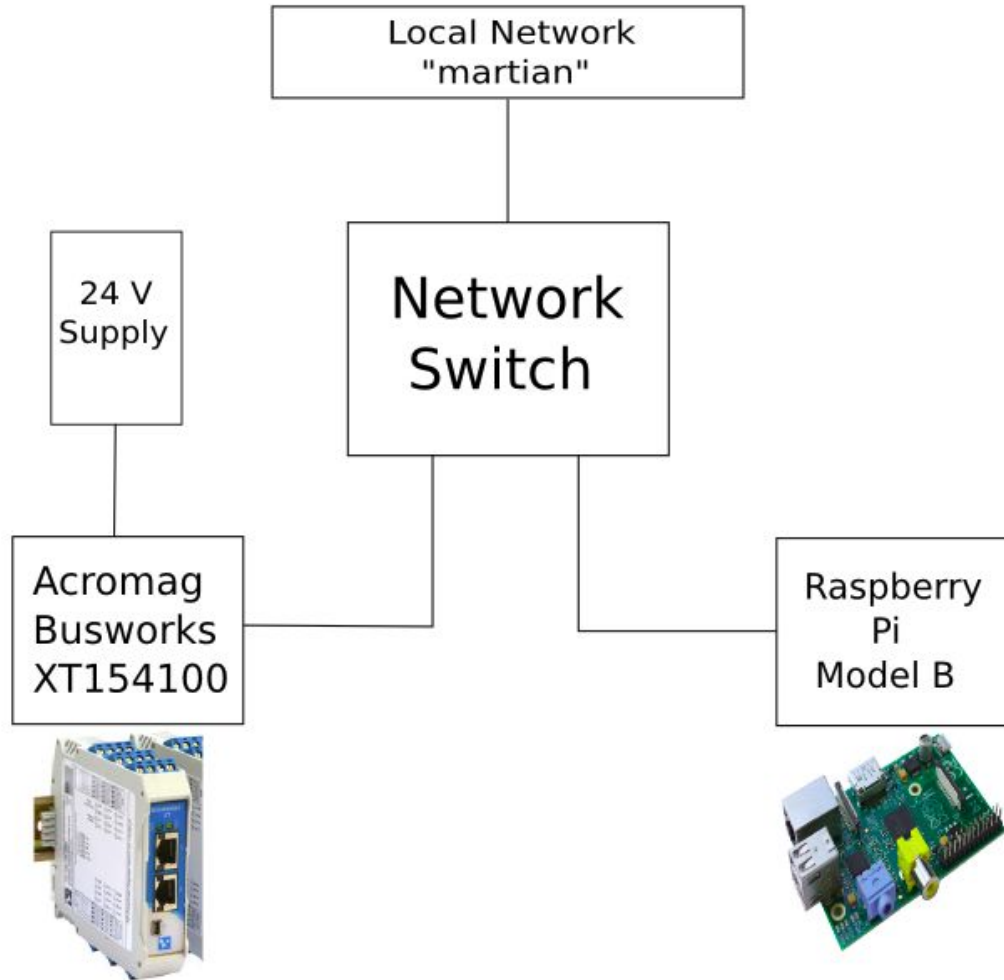
Configure as described by Aidan ATFWiki



Compile and install modules for linux-arm
from source by LLO CDS



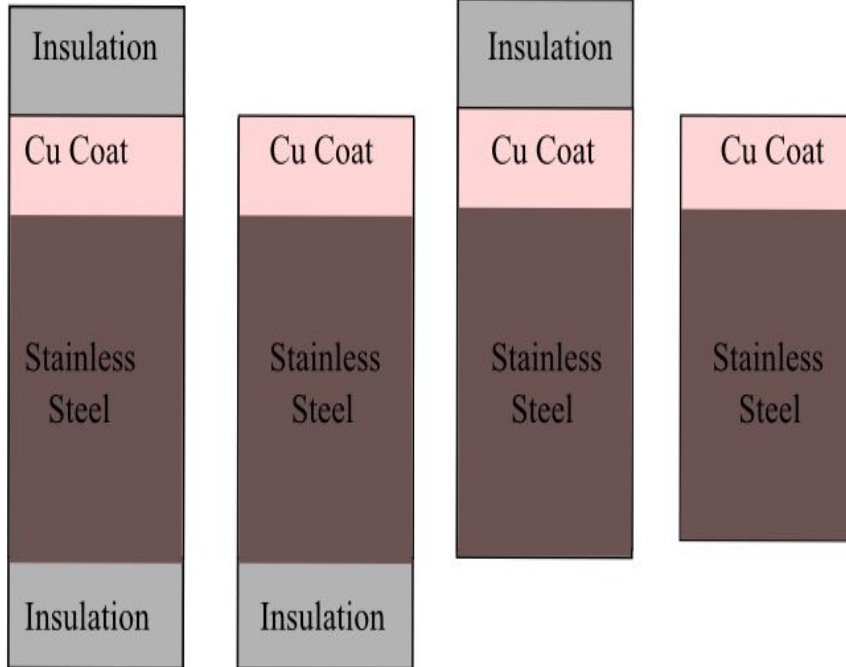
Create and test daq command and database



Seismometer Enclosure

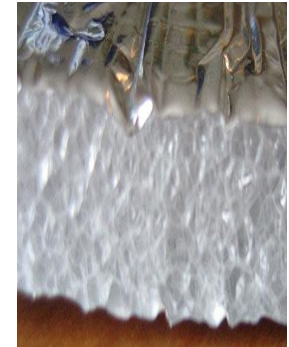
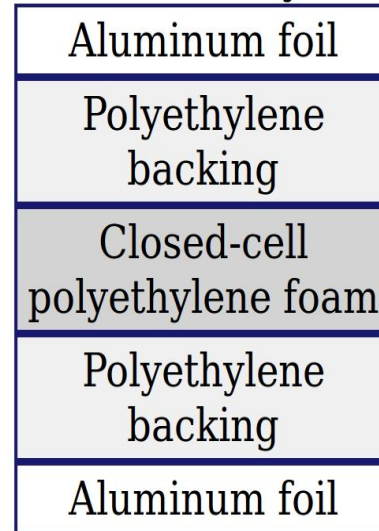
Combinations

INSIDE



OUTSIDE

Insulation

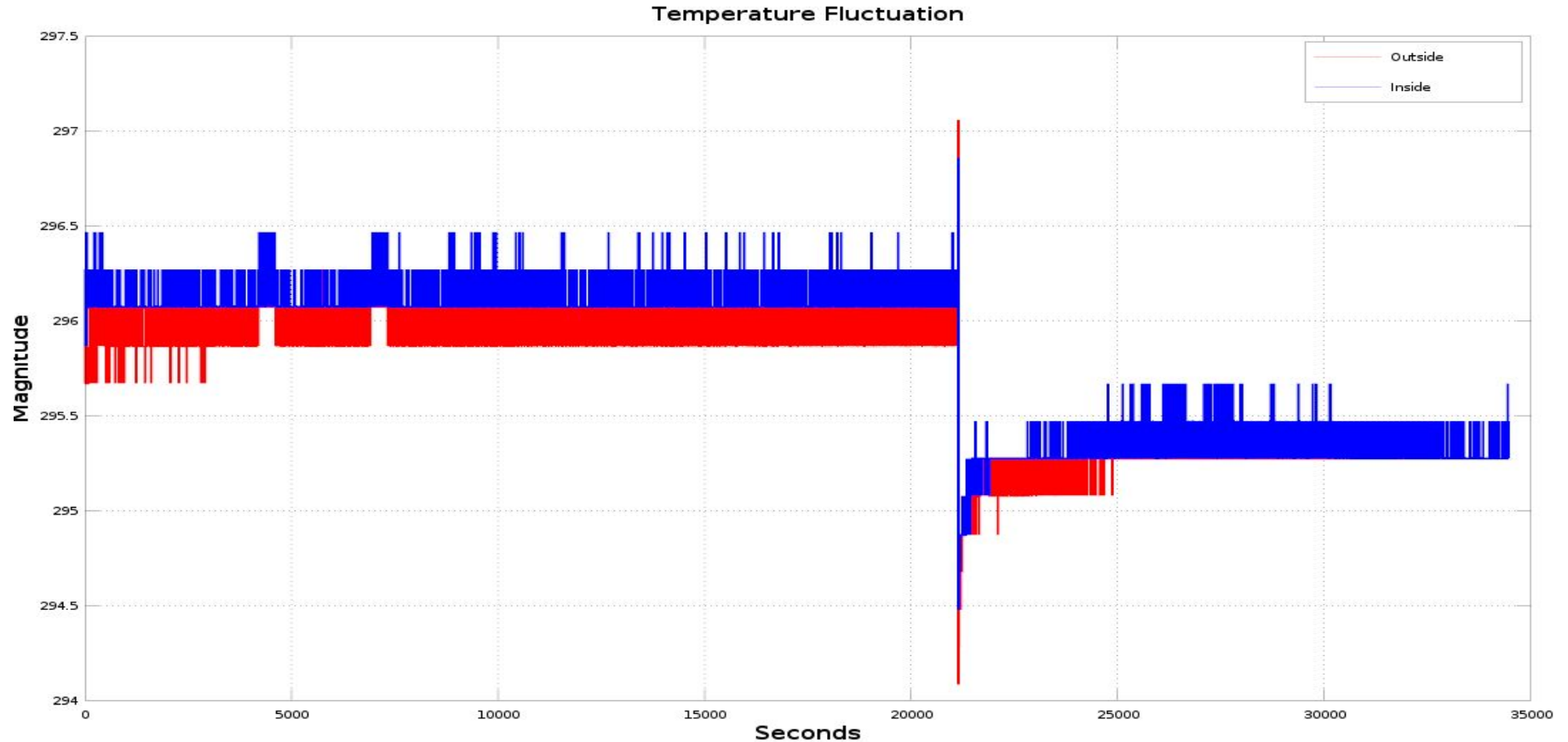


5 mm

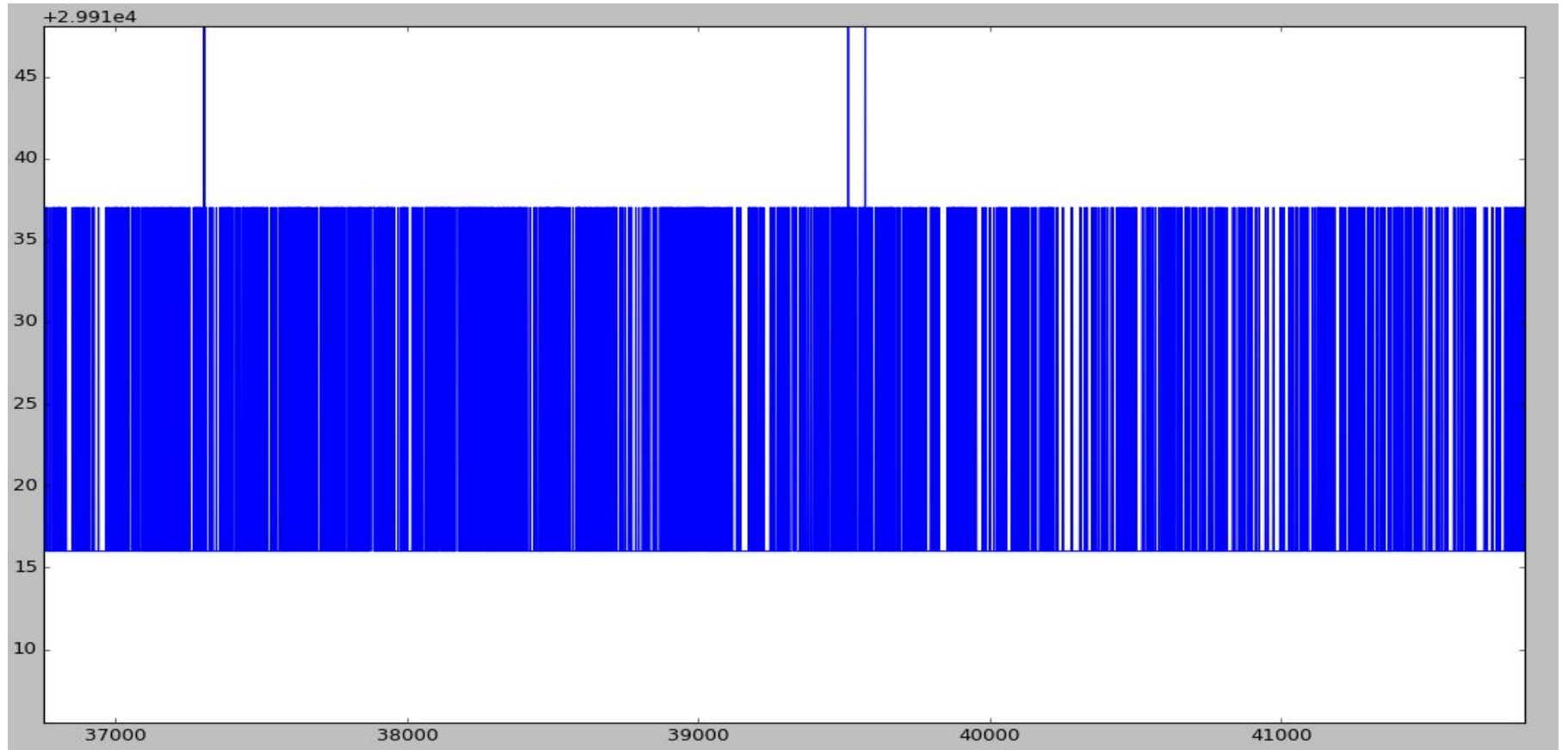
Seismometer & Enclosure



Temperature Measurement



ADC Noise



Future Work

- ❑ Acromag setup
- ❑ Measure actual transfer function
- ❑ Design a temperature controller
- ❑ Characterisation of heater
- ❑ Enclosure clamping
- ❑ Connections to single seismometer wire.

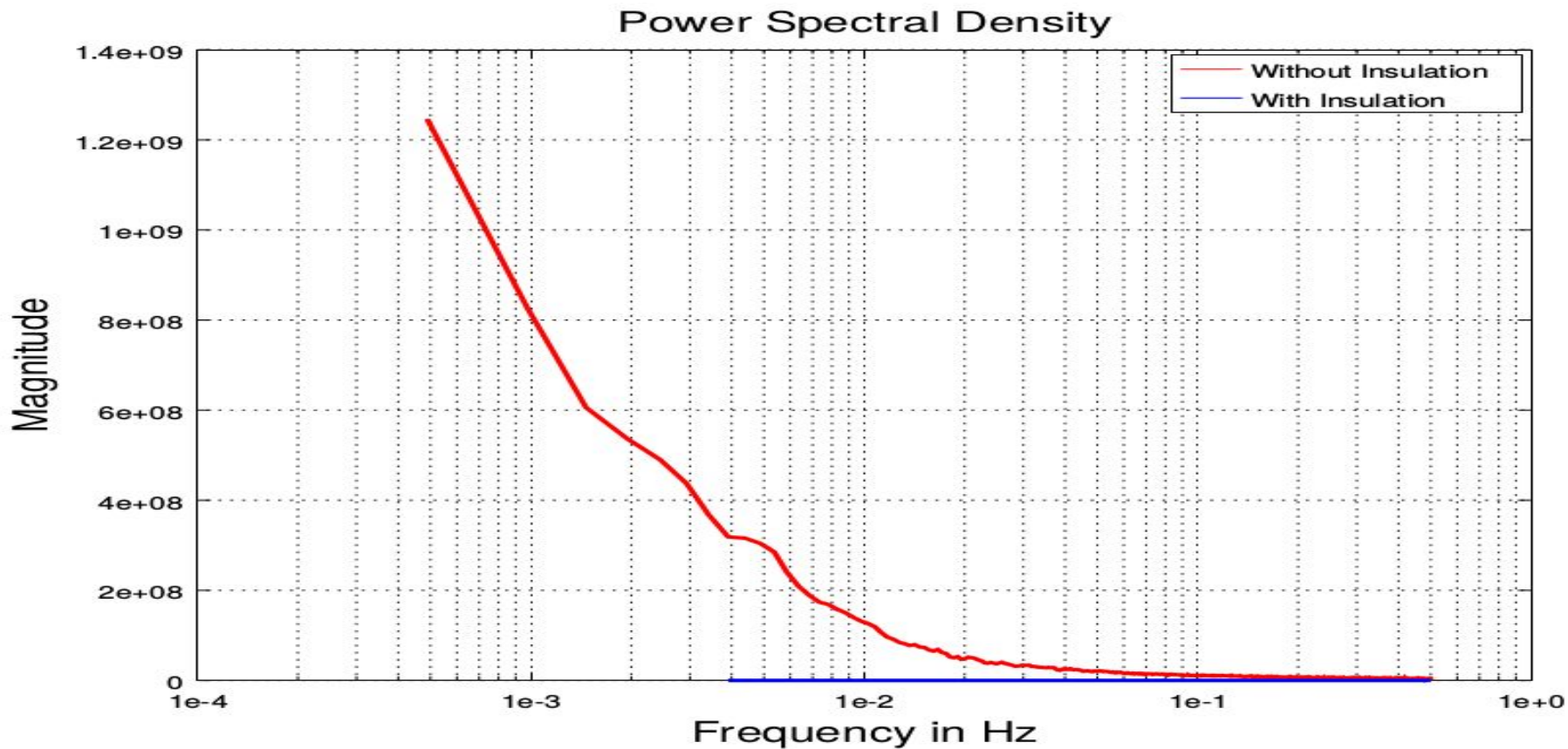
Summary

Insulation is applied to the enclosure.

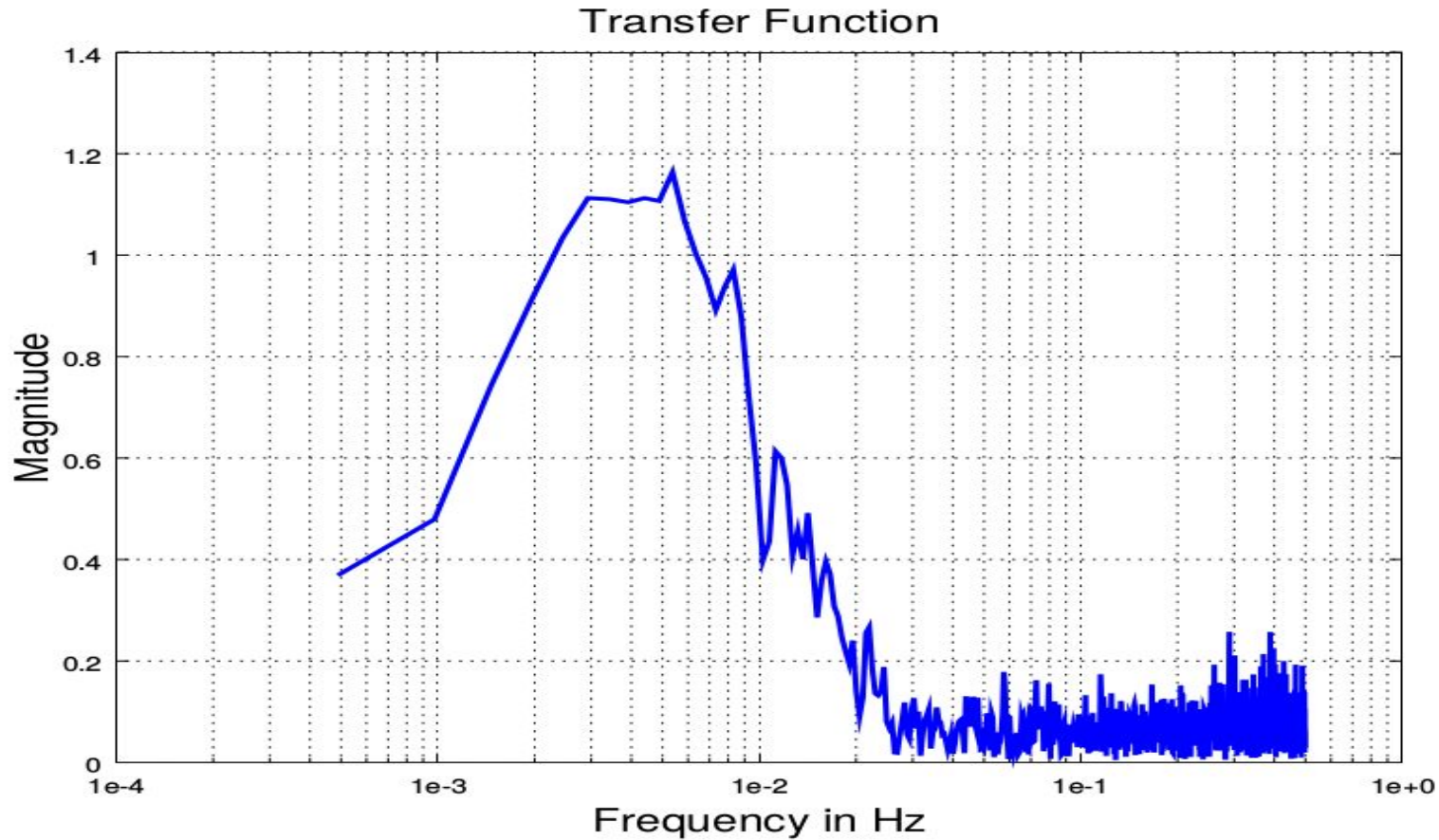
Problems in using RPi ADC have been identified.

Acromag Busworks I/O cards are NOT successfully installed and some problems remain to be solved.

Insulated and Uninsulated Enclosure

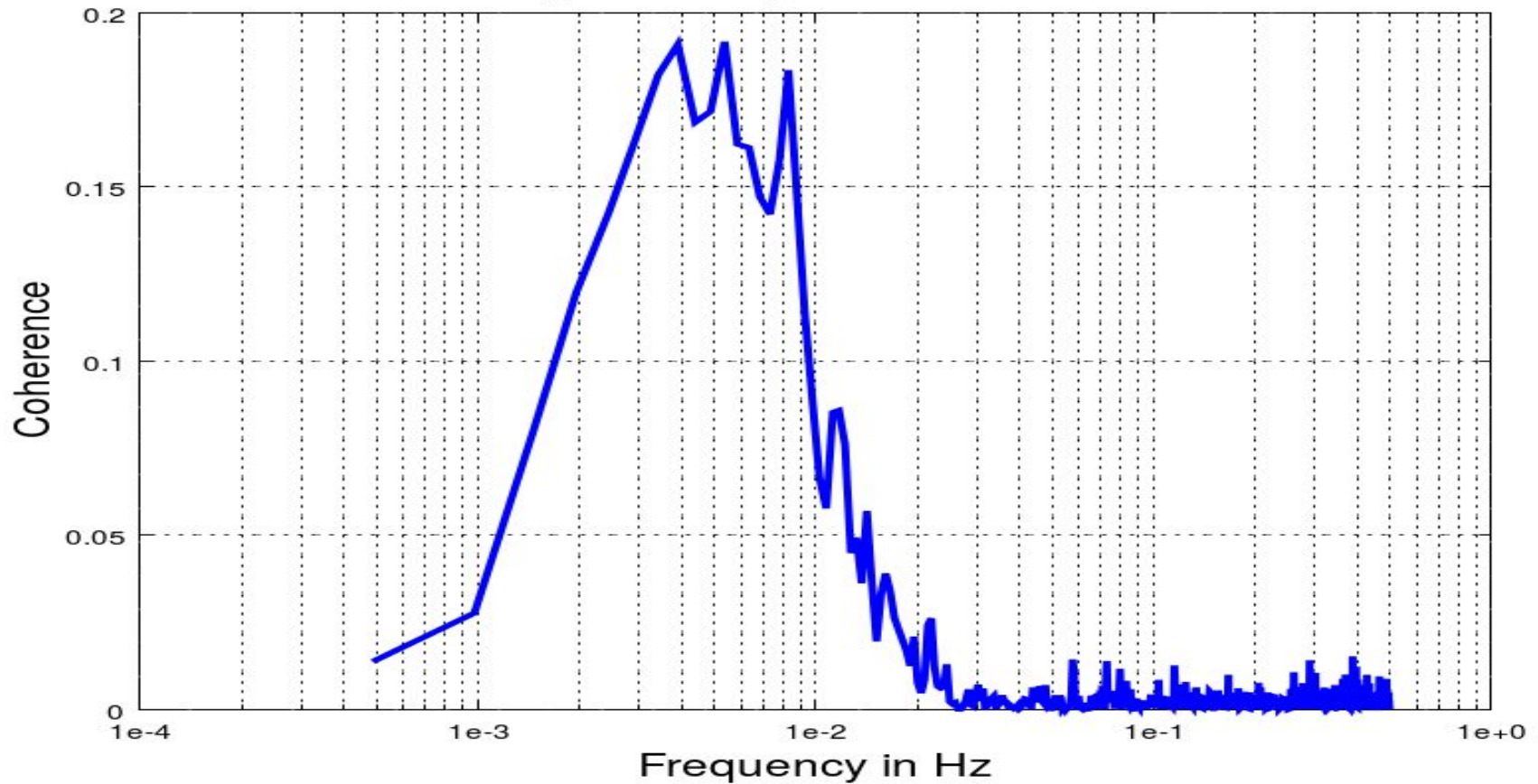


For Existing Enclosure

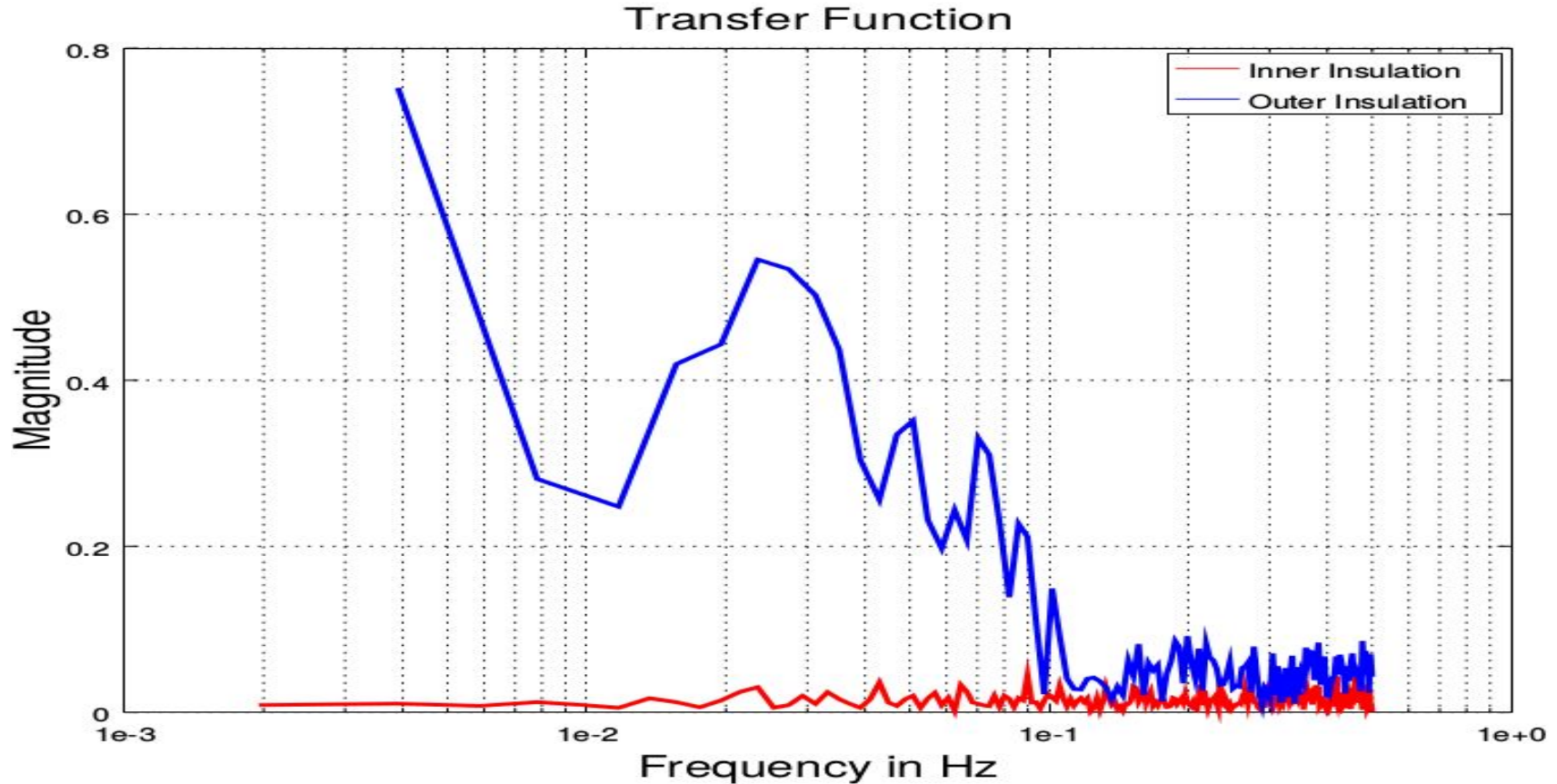


For Existing Enclosure

Magnitude Squared Coherence

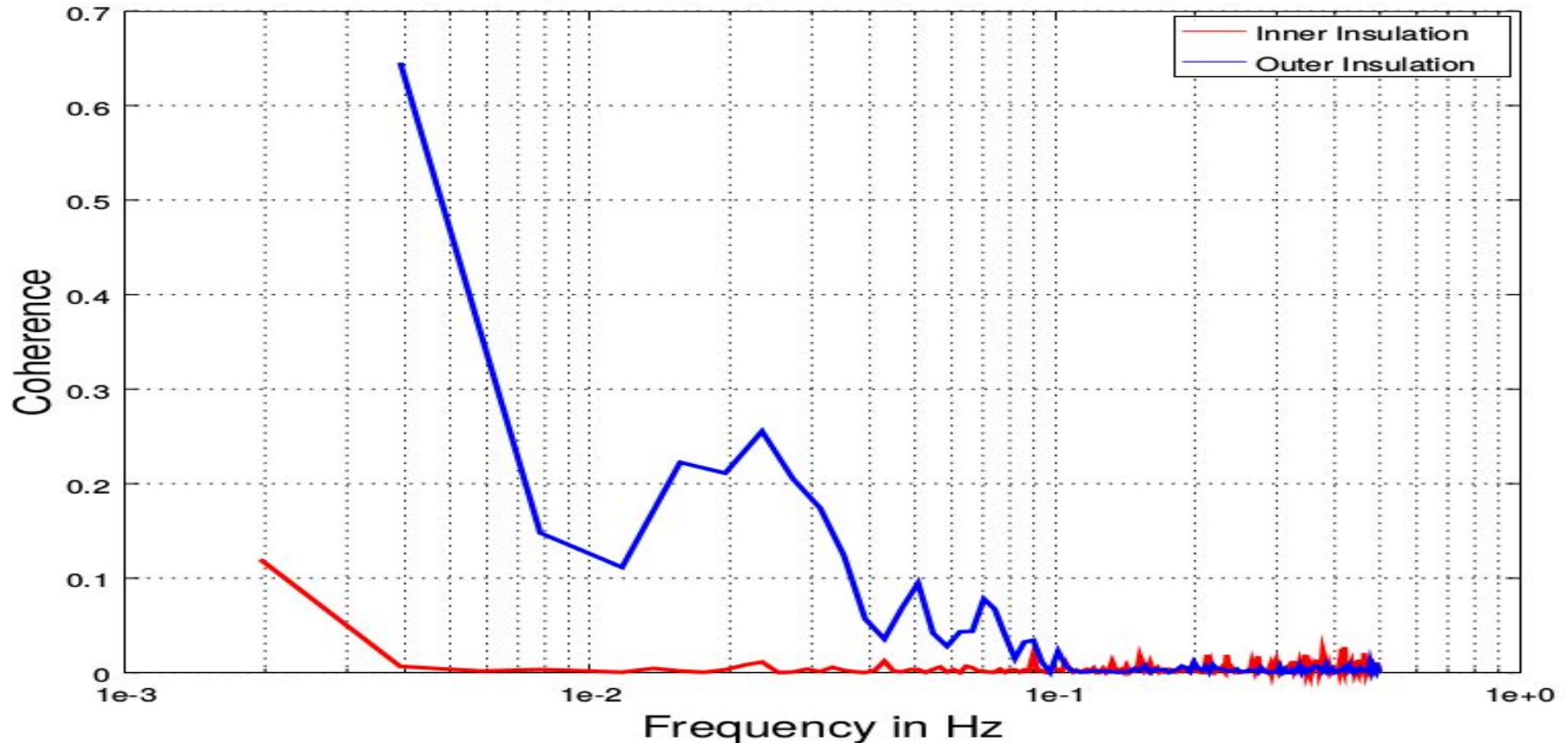


For Enclosure with One Sided insulation

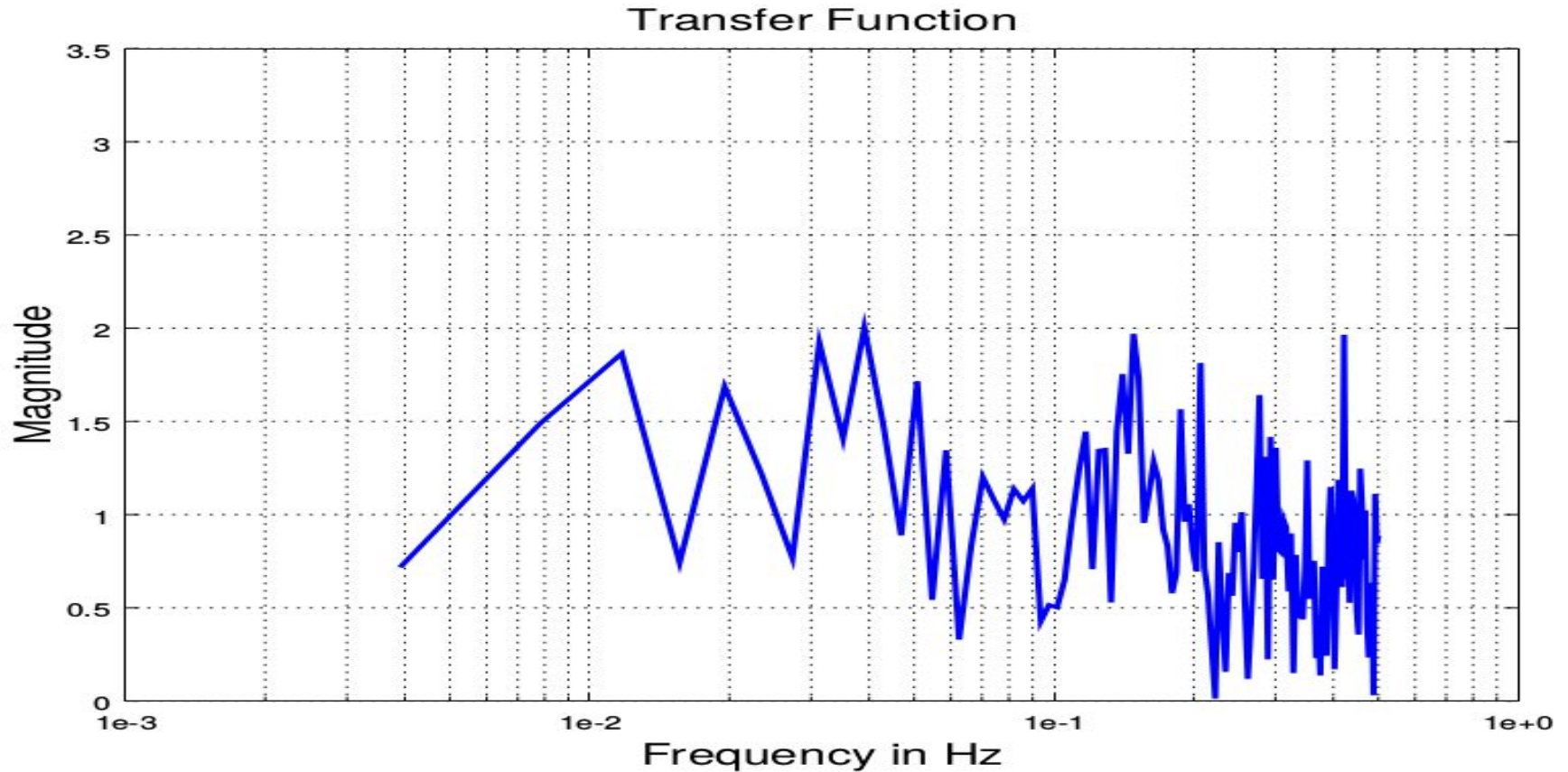


For Enclosure with One Sided insulation

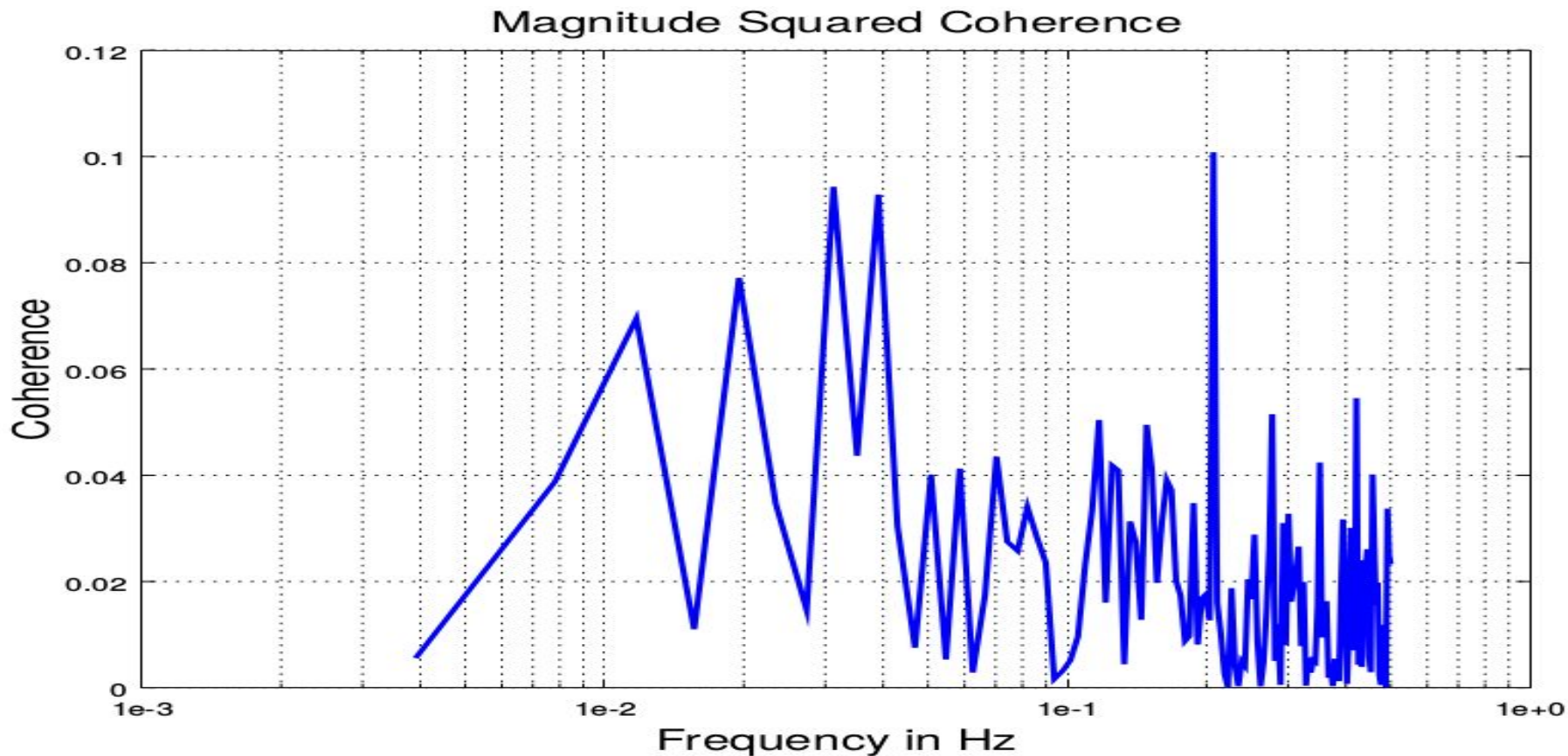
Magnitude Squared Coherence



For Enclosure with Two Sided Insulation



For Enclosure with Two Sided Insulation



PSD Data

```
octave:72> min(pxx1)
ans = 1.7612e+06
octave:73> max(pxx1)
ans = 1.2466e+09
octave:74> min(pxx2)
ans = 1.0575
octave:75> max(pxx2)
ans = 10.445
octave:76> mean(pxx1)
ans = 1.7290e+07
octave:77> mean(pxx2)
ans = 3.7990
```

Data

strength of association between two series or power transfer between input and output of a linear system. For an ideal constant parameter linear system with a single input and single output , the coherence will be equal to one.

$$U = \frac{1}{R} = \frac{\dot{Q}_A}{\Delta T} = \frac{k}{L}$$