



Environmental vibrations database for kinetic energy harvesting

Igor Neri

This project is part of **NANOPOWER** project and it is devoted to the realization of database containing digital time series and spectral representations of experimentally acquired vibration signals.

Department of Public Health and Clinical Medicine
Occupational and Environmental Medicine

Research

Welcome to the databases for Vibration Machines

The information stored in this database is compiled from research reports, power tool catalogues, etc.

Click on the links to reach each database.

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[Exposure Calculator for Hand and Arm Vibration](#)

[Whole-Body Vibration](#)

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Manufacturer	Hitachi
Model	D 10DGX(1HCK)
Power supply	Battery
Weight	1.40 kg
RPM	0-500/0-1000 rpm



Declared CE statements

Vibration value	2.5	m/s^2	Uncertainty	m/s^2	Measure Standard	EN / ISO 8662
Sound Pressure Level	70.0	dB(A)			Measure Standard	
Date of Measurement	Jan 01, 1994					

Data modified on Dec 13, 2001

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Accelerometry

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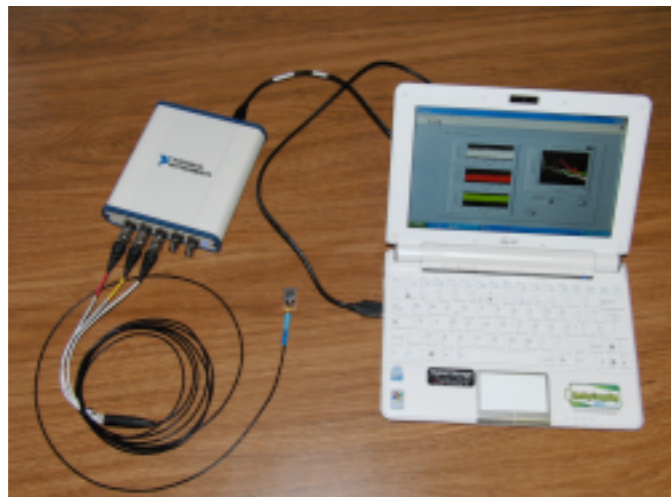
Outline

- Vibration Database
 - Acquisition kits
 - Methodology
 - Storage and presentation
- Examples
- Energy Harvesting applications
 - Simulations
 - Experiment

Vibration Database

Acquisitions Kits

The data present in the database are acquired using two acquisitions system

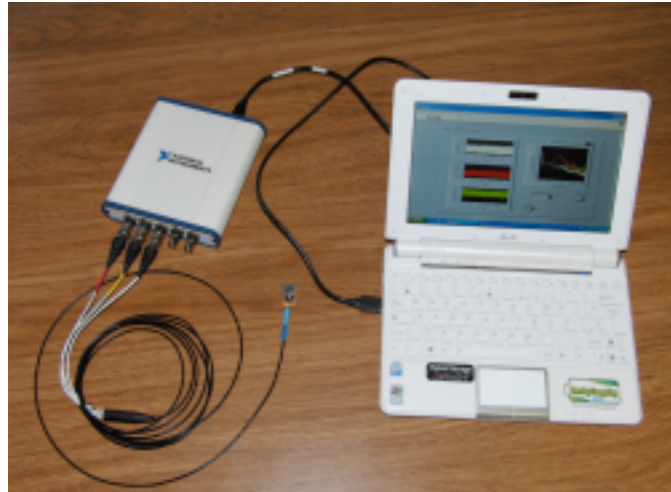


Kit-1



Kit-2

Kit-1



Accelerometer



- Model 7132A Measurement Specialist
- Bandwidth 0.4 - 9000 Hz (2dB)
- Natural frequency 37 kHz
- Sensitivity 100mV / g
- Residual noise (g RMS) 0.0005 g
- Weight 14 grams

Kit-2

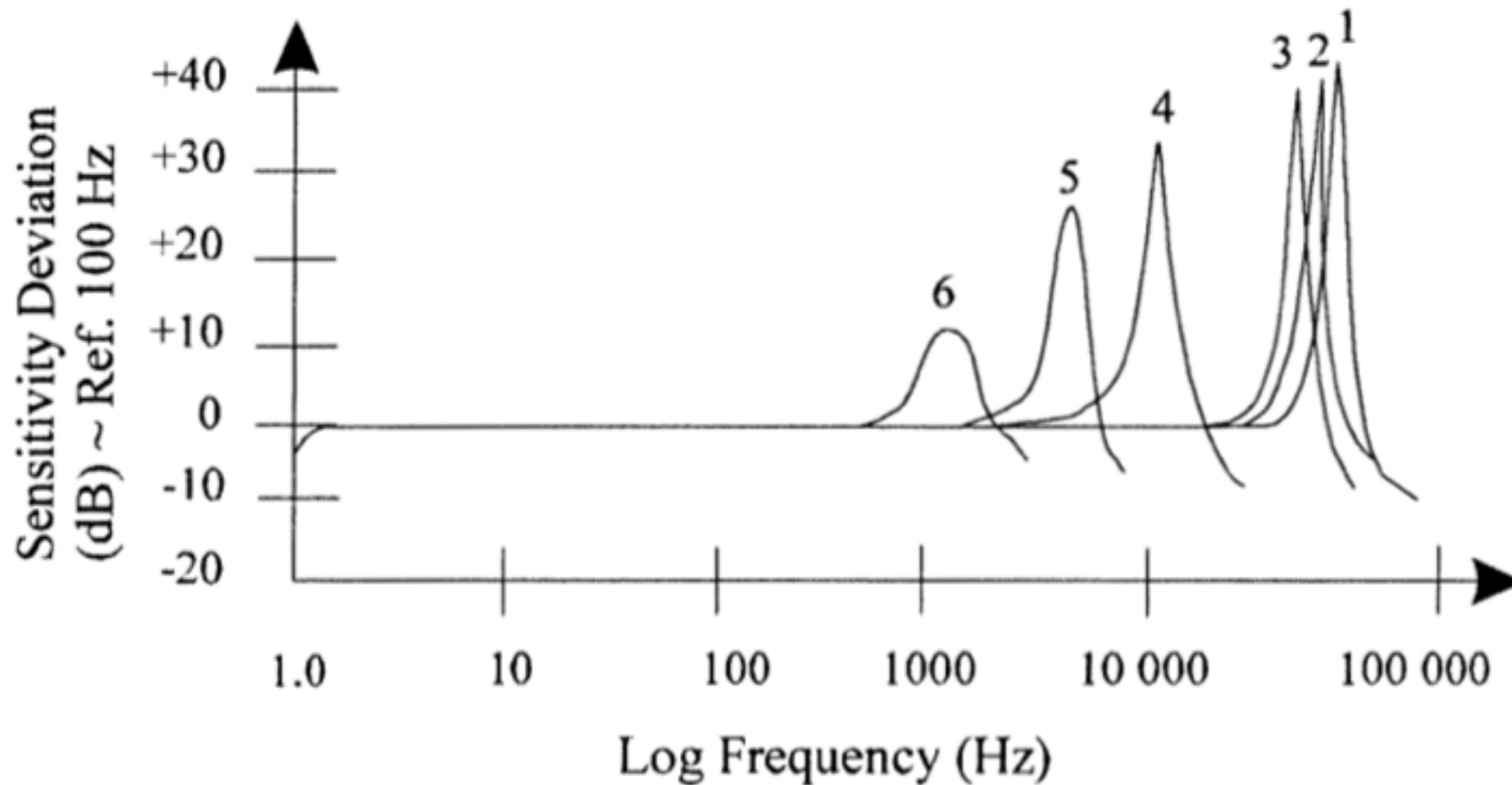
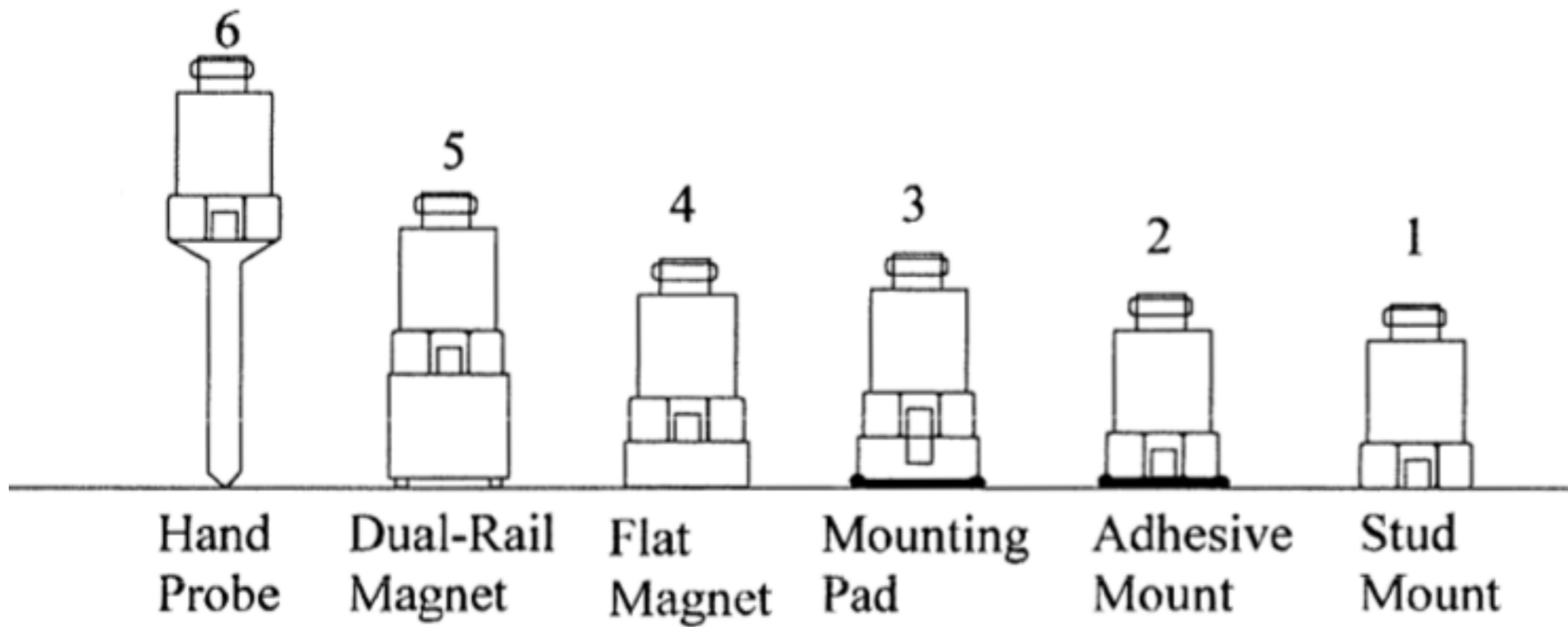


Slam Stick™ Vibration Recorder

- Max Acceleration (each axis) 16 g
- Sampling Rate (each axis) 3.2 kHz
- X,Y axis noise 0.016 g
- Z axis noise 0.022 g
- Max Recording Time at 3.2 kHz 240 s
- Weight 14 gram

Acquisition Methodology

- Expected Frequency Content (Sampling Frequency, Acquisition time)
- Amplitude (Resolution, Sensitivity)
- Sensor - Source ratio
- Mounting conditions



Acquisition

Once determined the Kit to be used and the acquisition parameters the acquisition can be performed. At the end of acquisition process a data file is produced containing:

- acceleration time series
- metadata information
- PSD plot

This file is used to automatically create an entry on the database.

Database Interface

The database interface is realized using the Content Management System Drupal that provide a web interface to navigate, search and download the vibration data.



Real Vibrations

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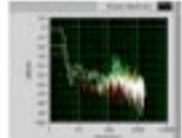
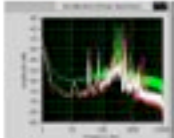
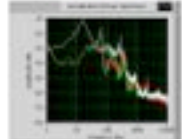
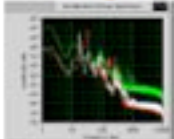
User login

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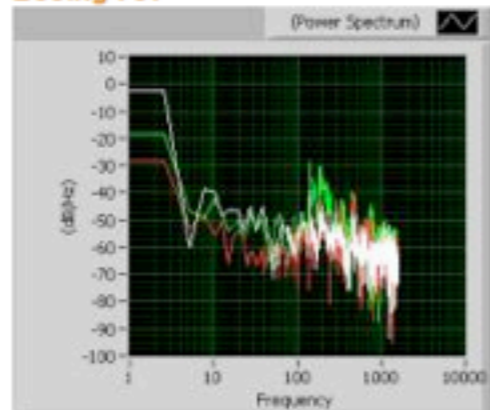
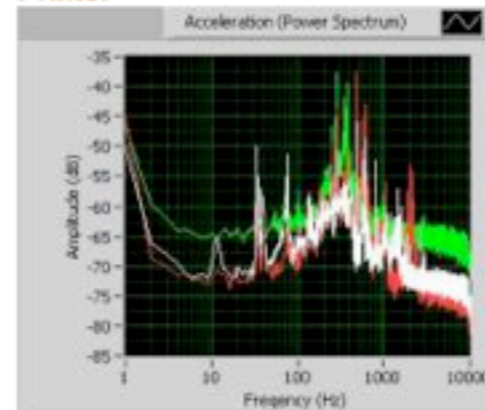
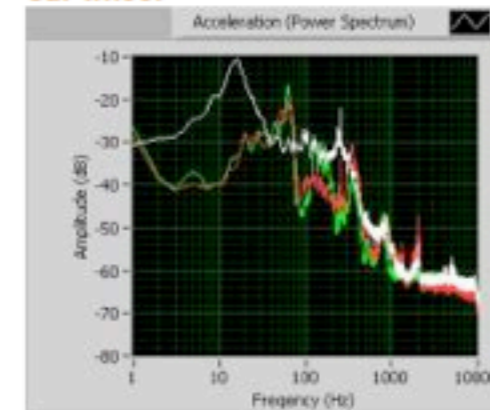
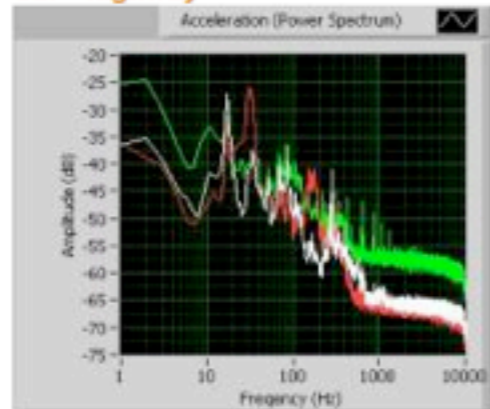
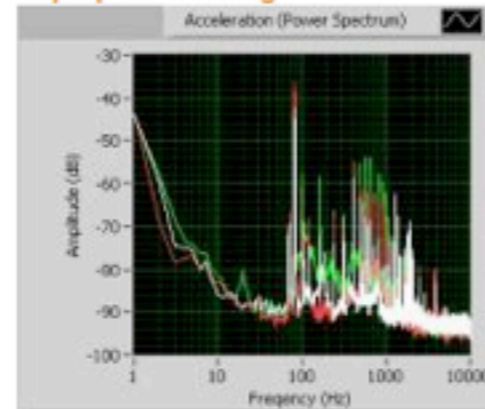
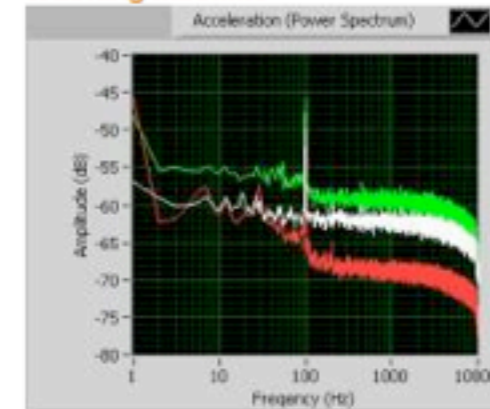
Password: *

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Signals

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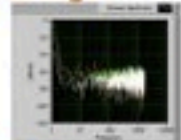
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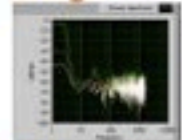
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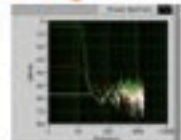
Bridge



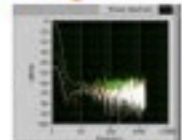
Bridge



Bridge



Bridge



Home

Signals

Title	Length	Sampling Rate	X std	Y std	Z std
Bridge	146s	3131Hz	0.0278051390 g	0.0736495140 g	0.0388193830 g
Bridge	189s	3132Hz	0.0178800930 g	0.0235467540 g	0.0754142800 g
Bridge	141s	3160Hz	0.0543920480 g	0.0527822120 g	0.1469135200 g
Bridge	139s	3132Hz	0.0129486880 g	0.0171943920 g	0.0280452990 g
Bridge	221s	3146Hz	0.0140152590 g	0.0195079730 g	0.0665810300 g
Bridge	207s	3126Hz	0.0205656000 g	0.0188408430 g	0.0224730950 g
Bridge	173s	3121Hz	0.0175915390 g	0.0112768120 g	0.0230714210 g
Bridge	188s	3148Hz	0.0138813650 g	0.0212183100 g	0.0652998130 g
Metro	166s	3131Hz	0.0233427220 g	0.0488691410 g	0.0433741980 g
Metro	222s	3129Hz	0.0540379350 g	0.0208114290 g	0.0346288900 g
Bus	222s	3132Hz	0.0282047230 g	0.0512607690 g	0.0352468780 g
Bus	222s	3121Hz	0.0453785600 g	0.0743339540 g	0.0974663260 g

Real Vibrations

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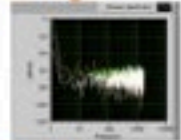
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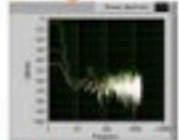
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Latest Signals

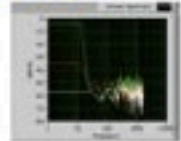
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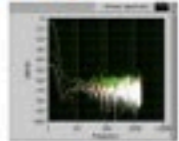
Bridge



Bridge



Bridge



Home

Aircraft

Submitted by Igor Neri on Thu, 02/24/2011 - 16:16

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Model: Boeing 737

Accelerometer position: fuselage

Status: landing

Note: gravity along X axis

Length: 222s

Sampling Rate: 3122Hz



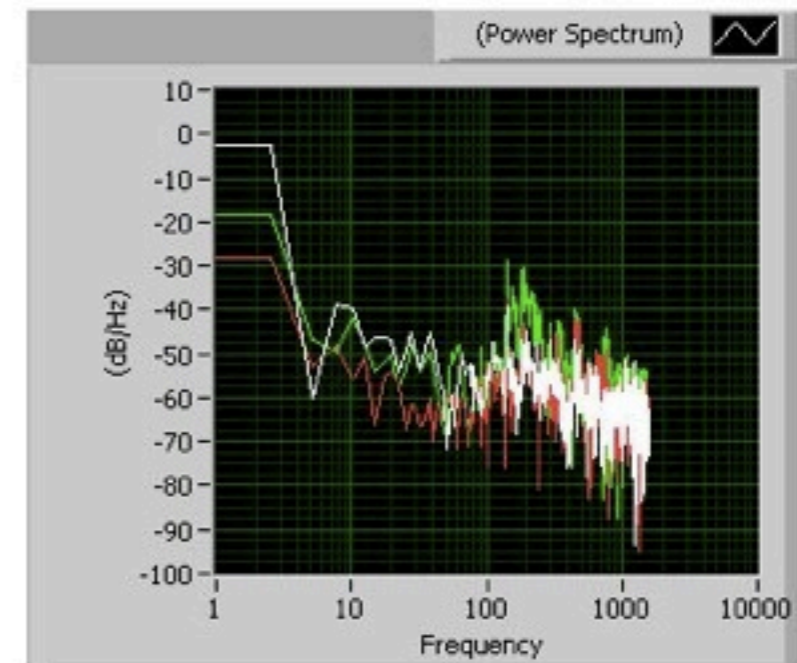
RMS

X: 1.0173740000 g
Y: 0.1241604080 g
Z: 0.2833397080 g

STD

X: 0.0877326940 g
Y: 0.1182722640 g
Z: 0.2301919550 g

Mean

X: 1.0135850000 g
Y: -0.0377822500 g
Z: -0.1652063200 g[previous](#) 18 of 98 [next](#)[Home](#) | [Signals](#) | [DAQ Kits](#) | [Info](#) | [Policy](#)

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Access Policy

Anonymous

- Description
- Power spectral density plot
- Statistical informations
- No download available

Authenticated users

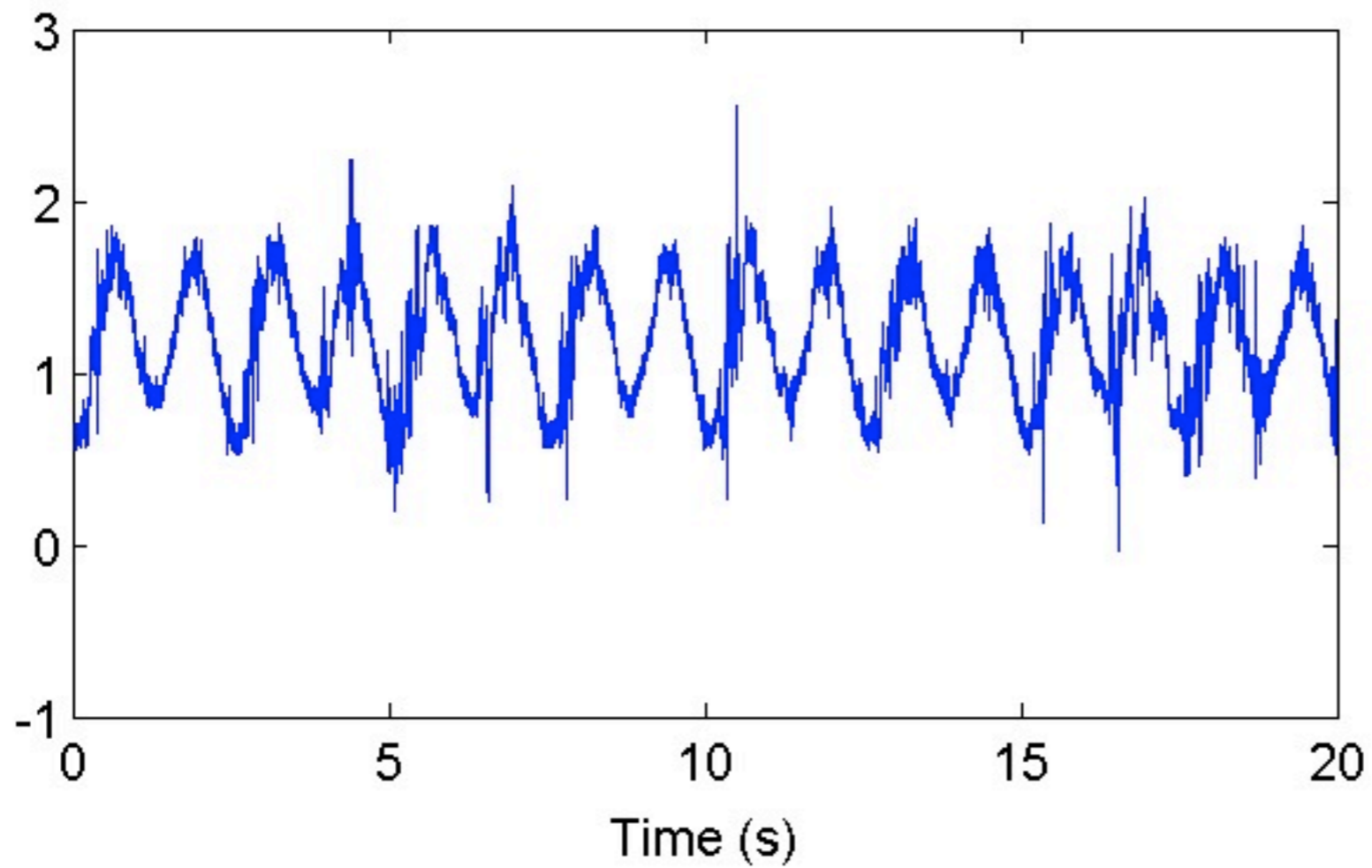
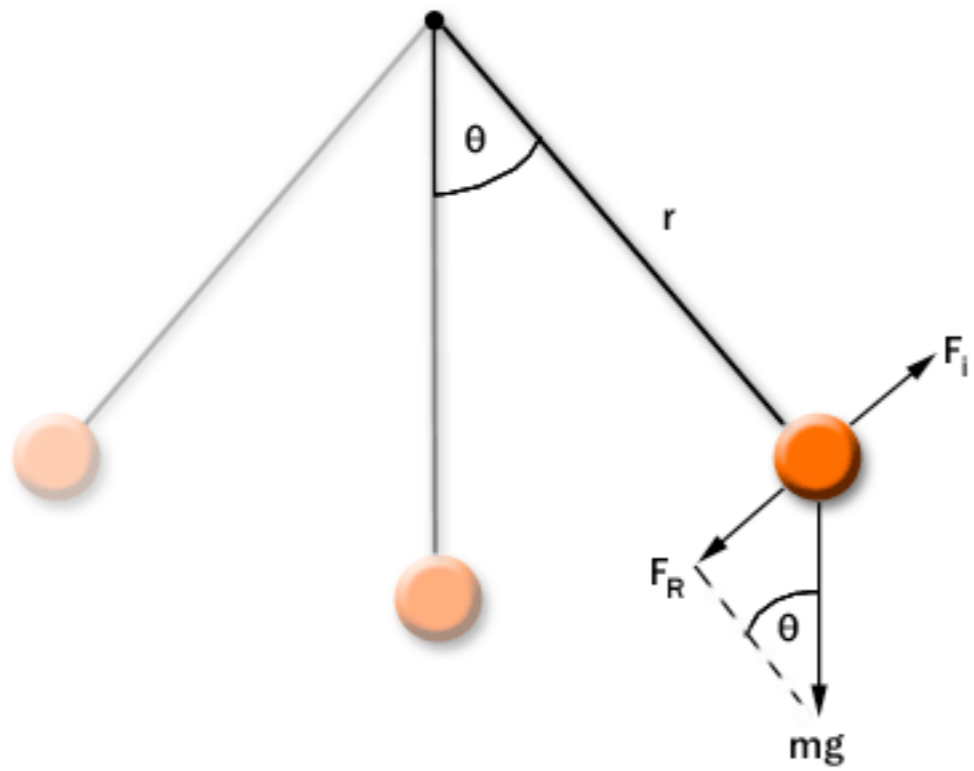
- Download available for a set of selected signals

Partnership users

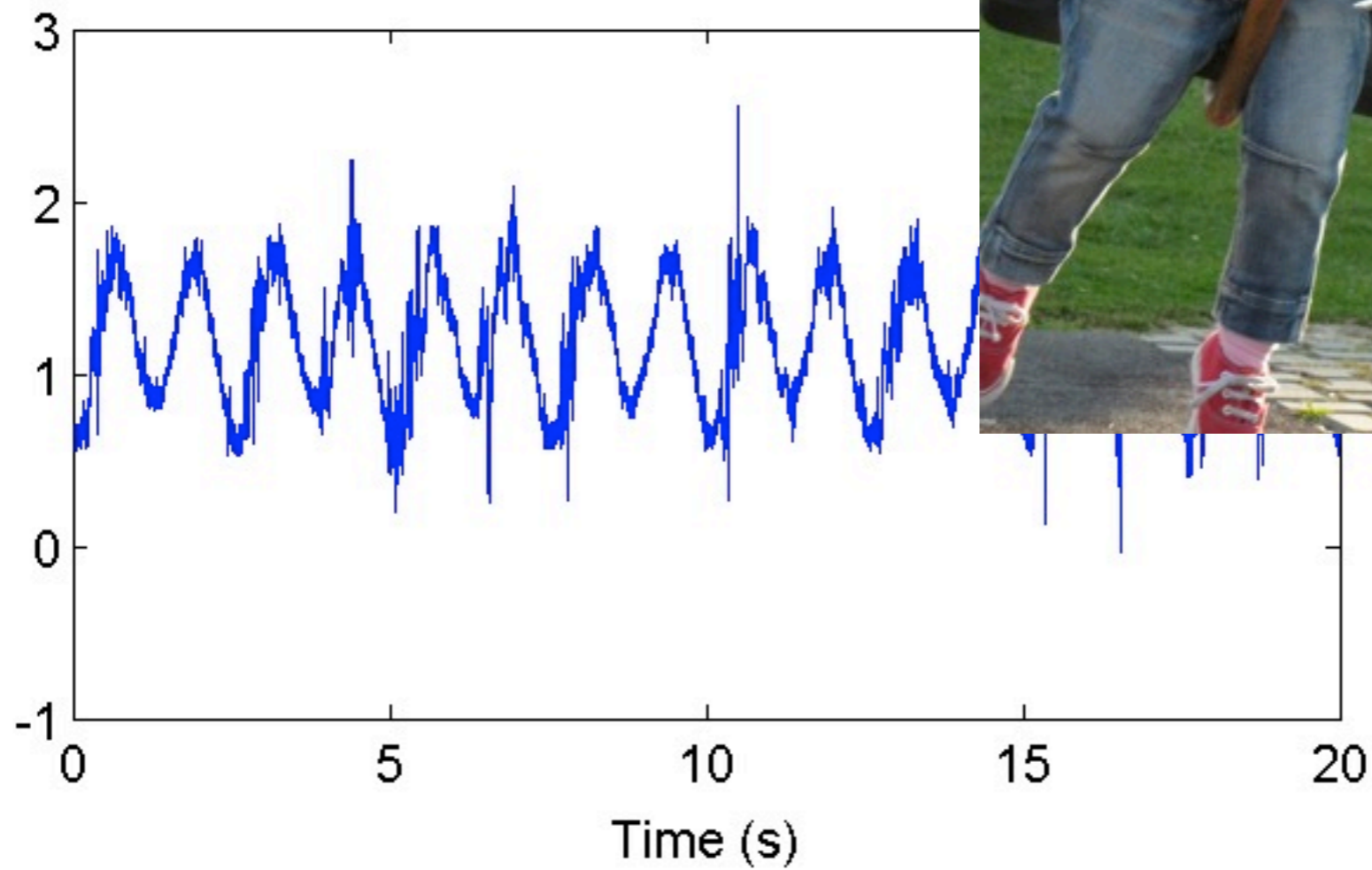
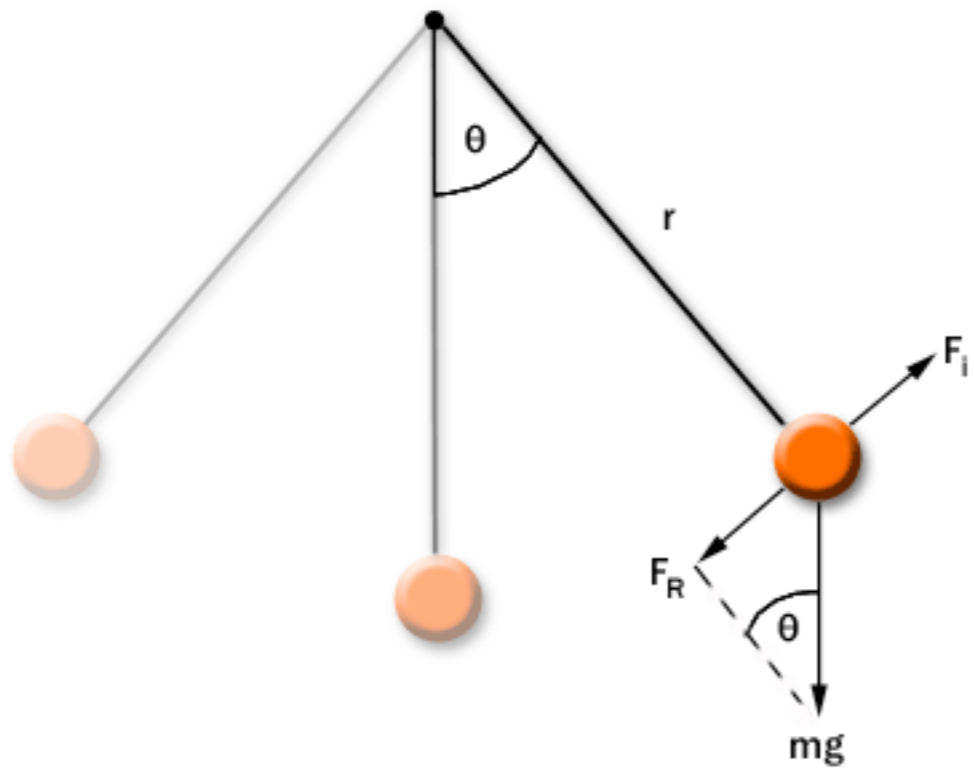
- Full download

Examples

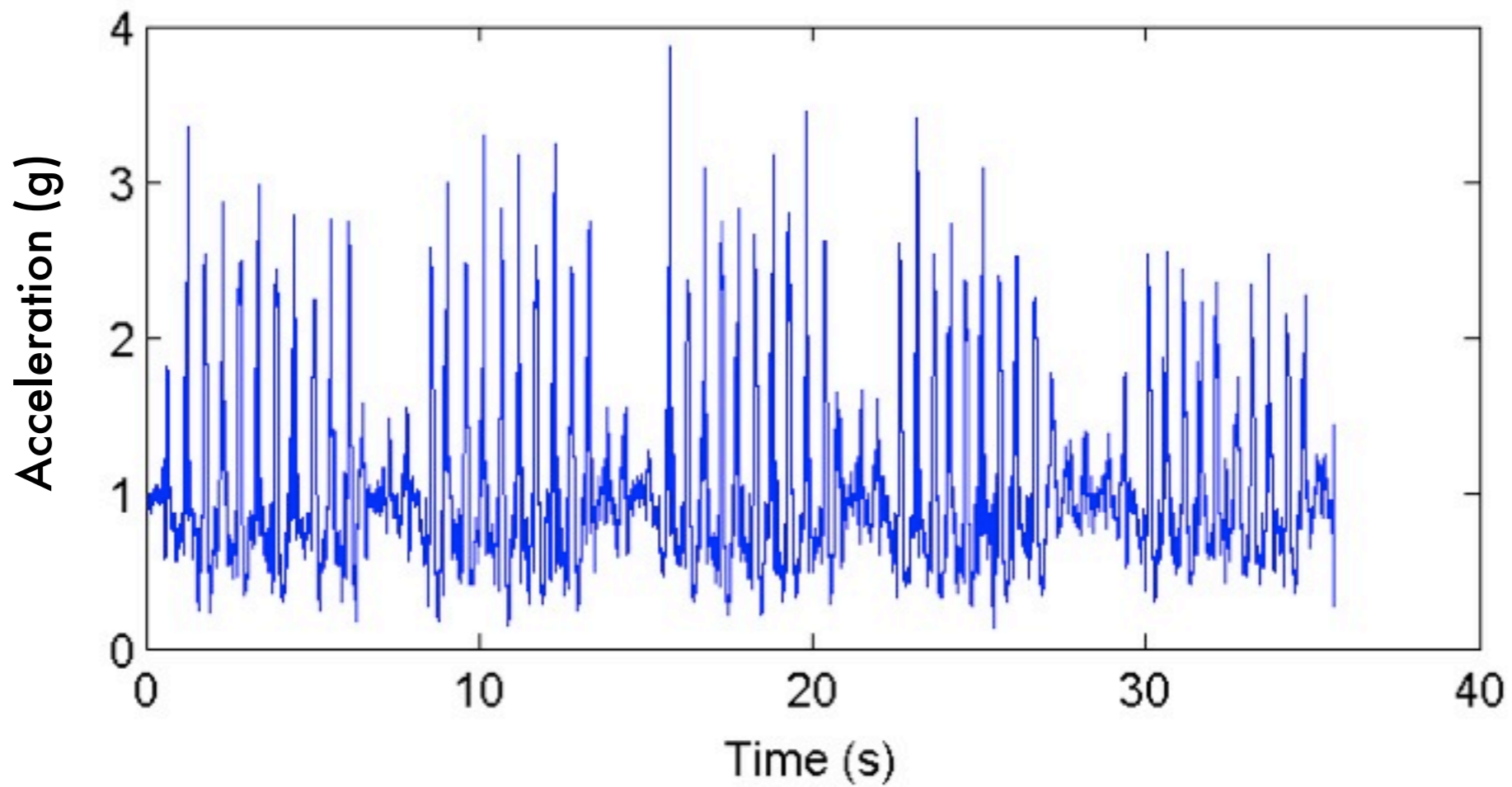
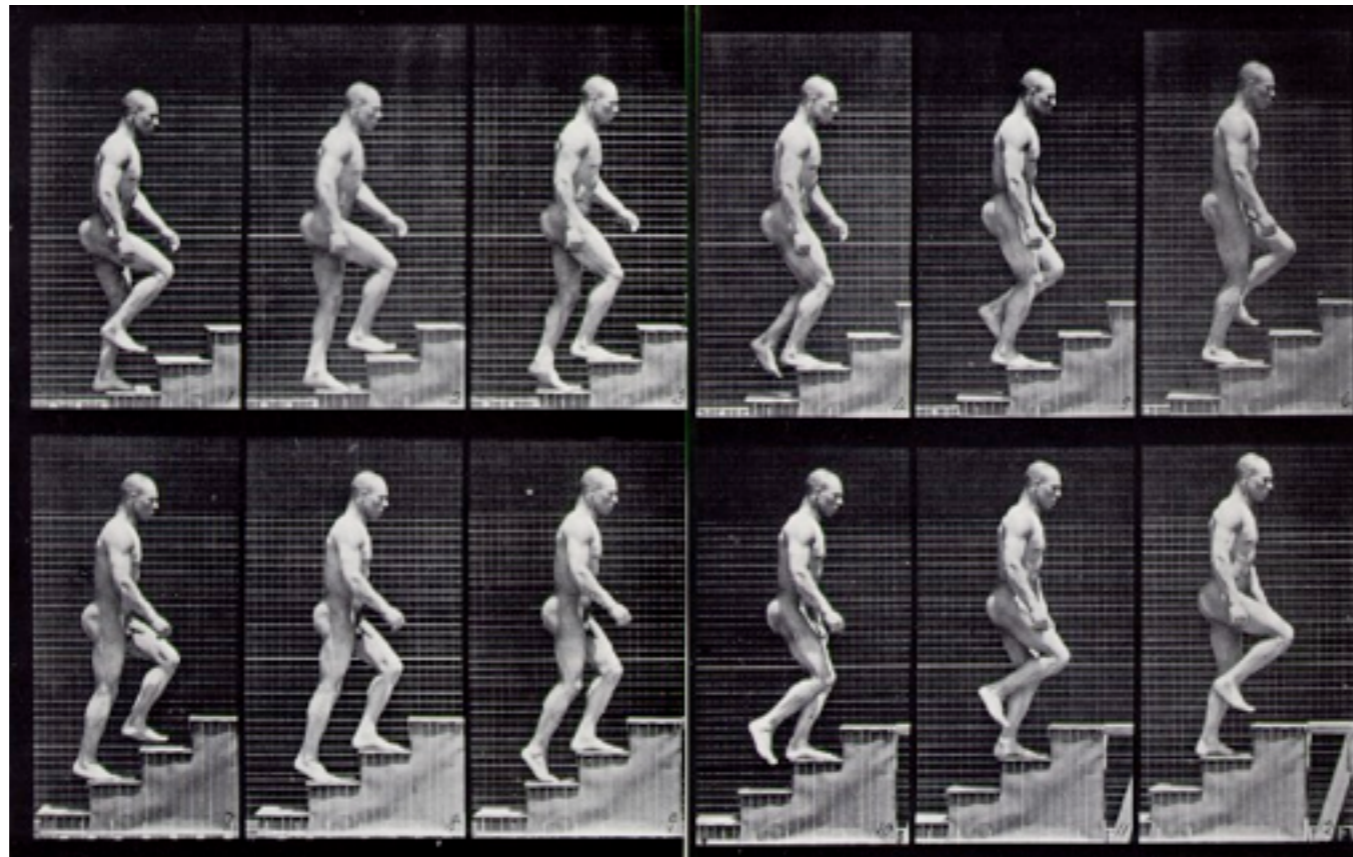
Pendulum...



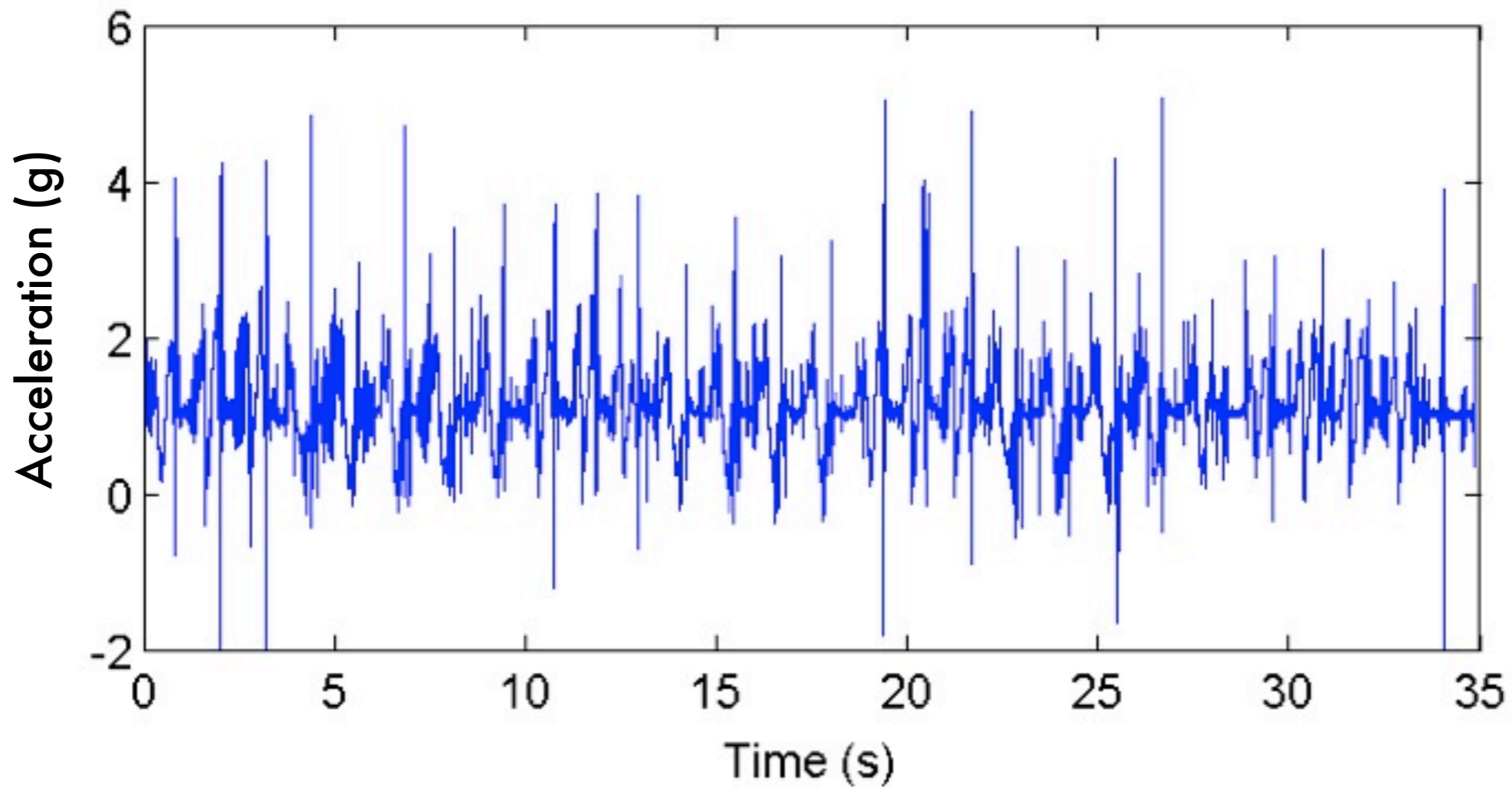
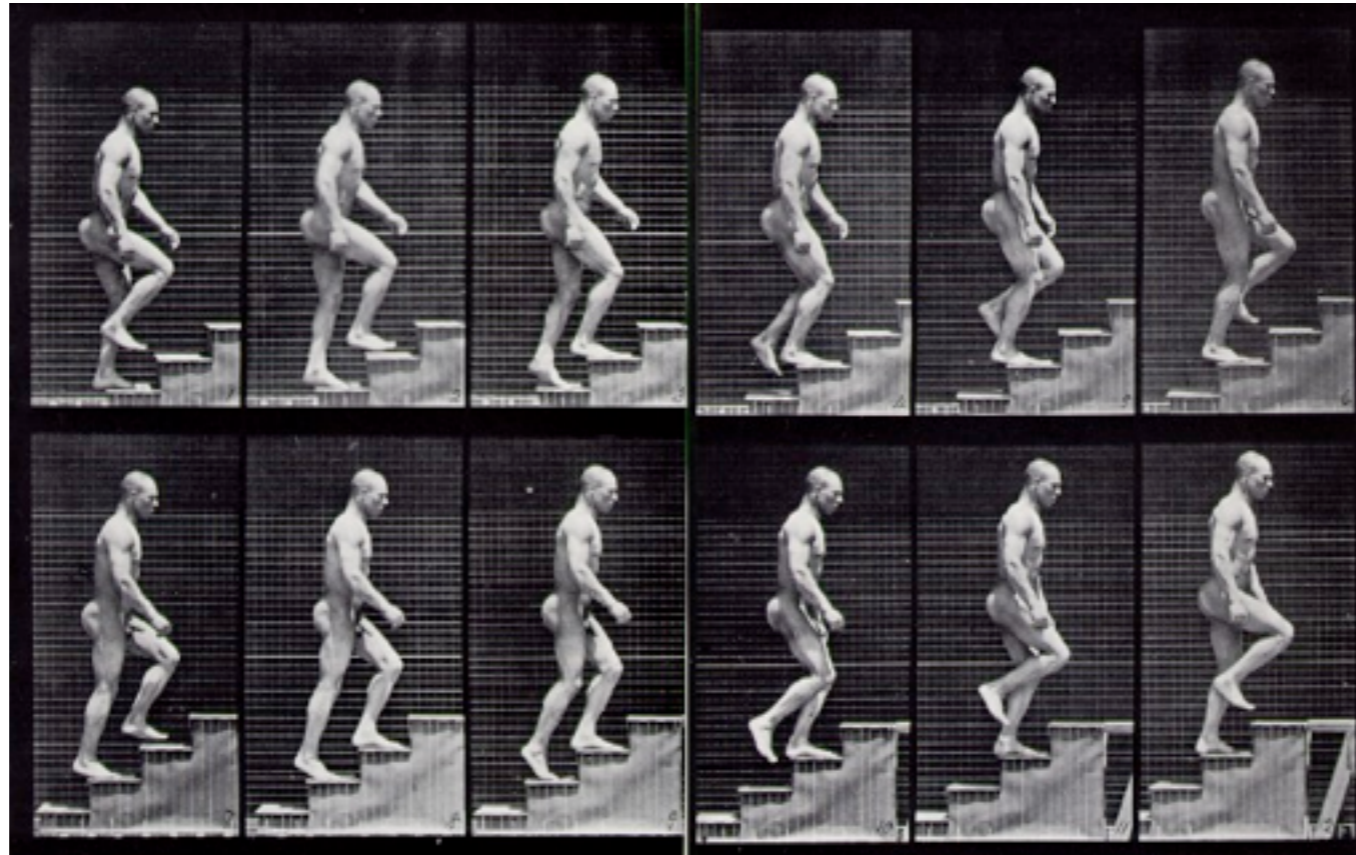
Pendulum...



Down stairs (belt)

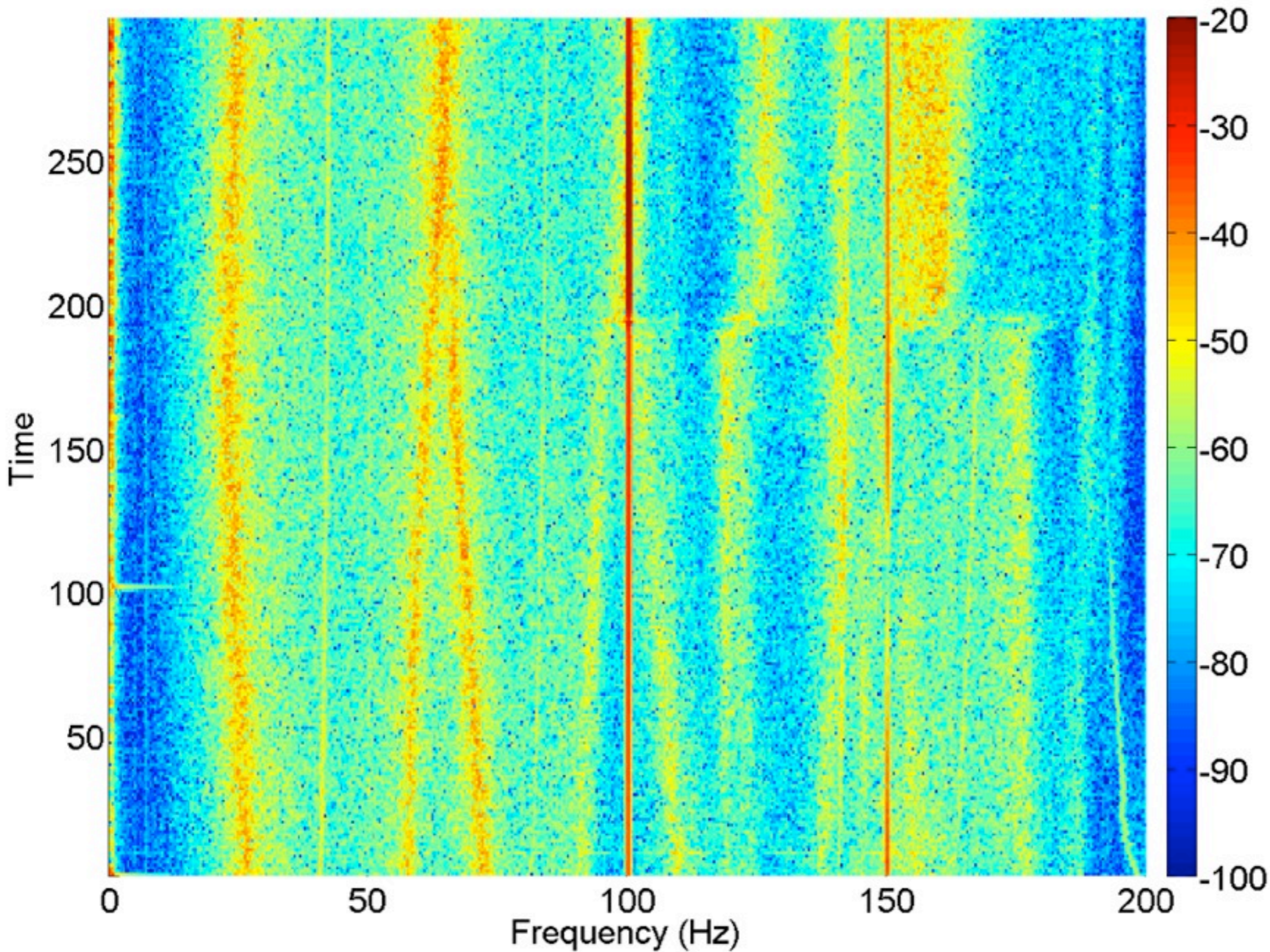


Climbing stairs (ankle)



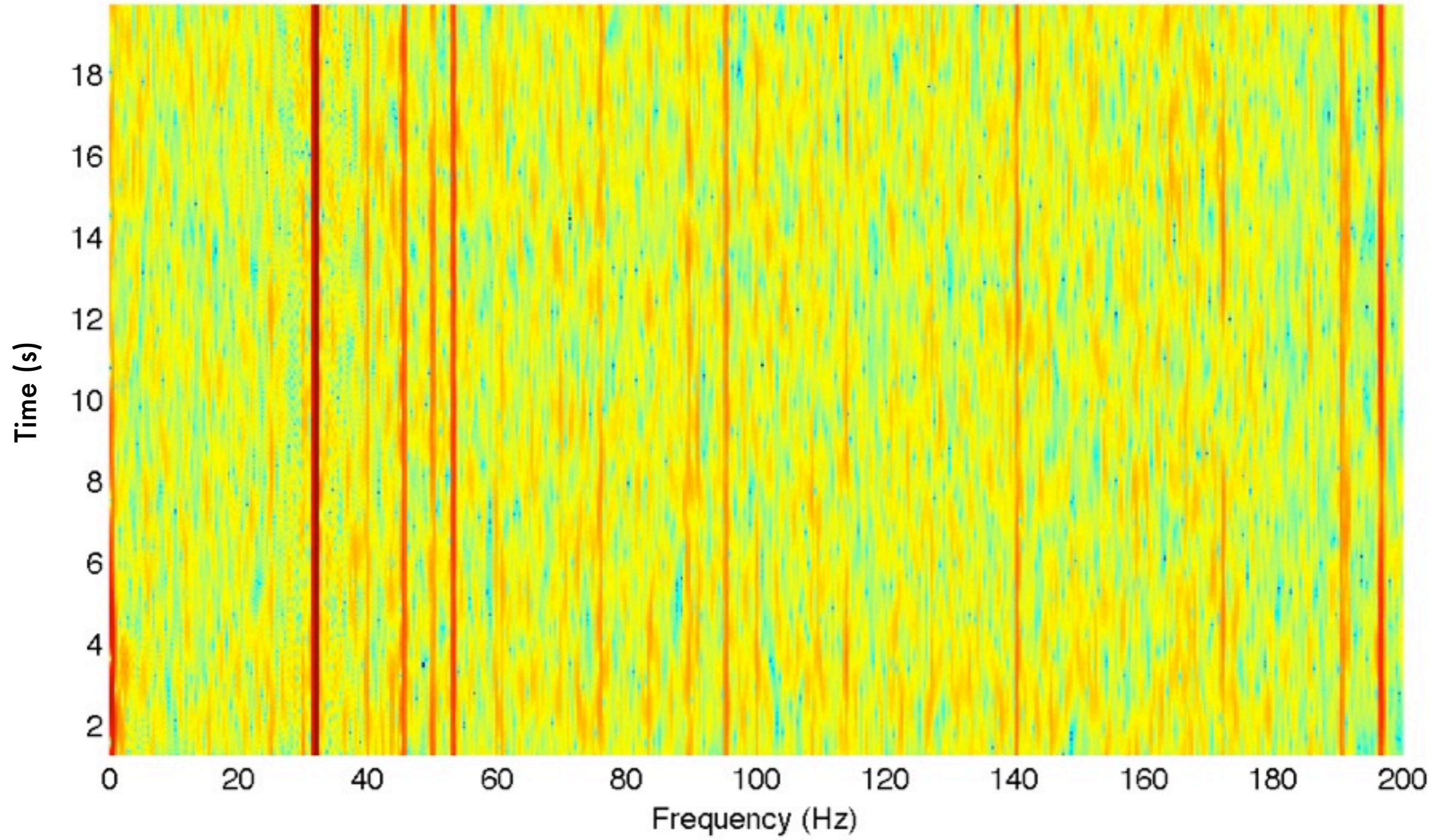


Microwave Oven





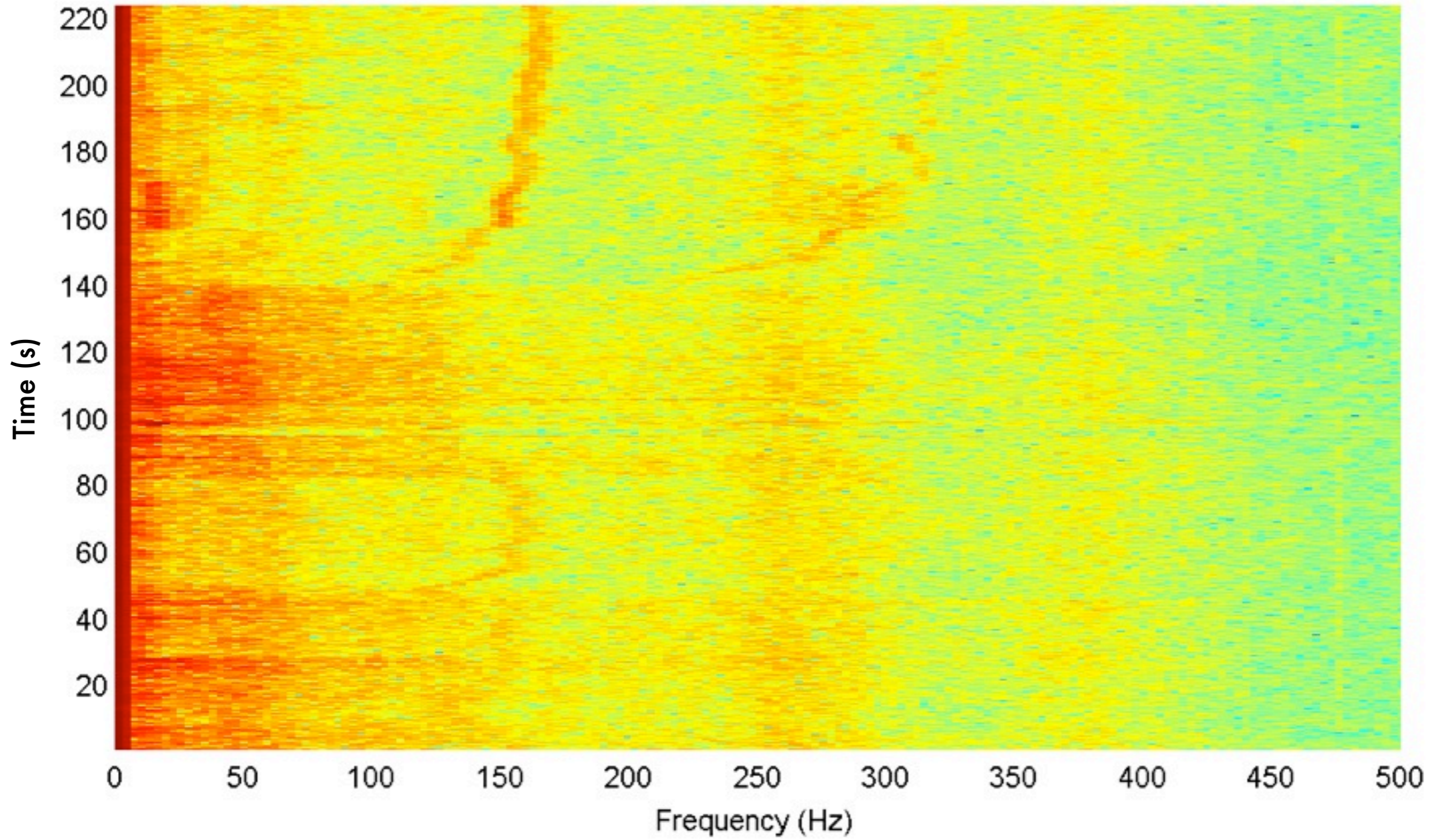
Milling cutter



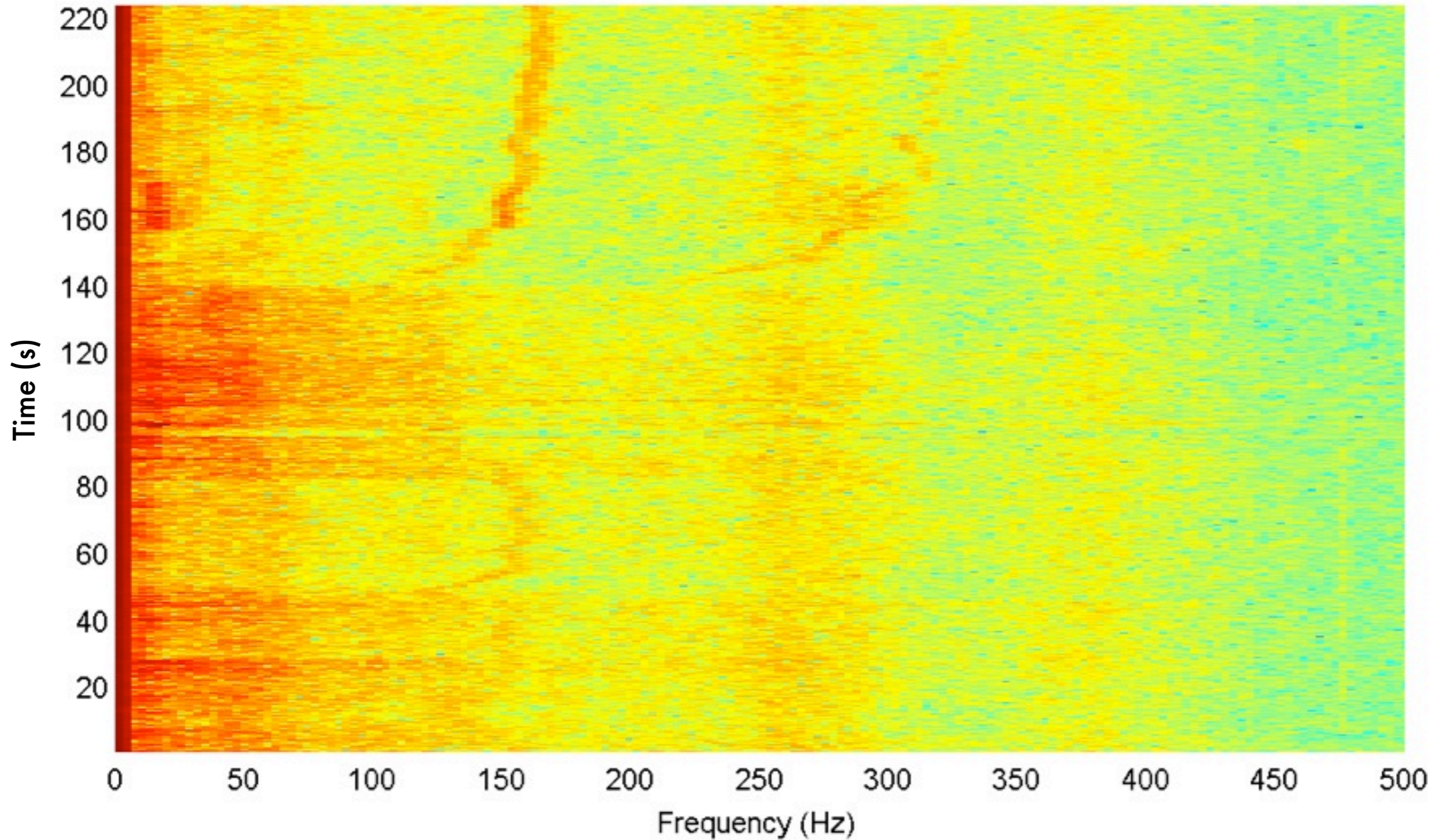
Automotive... with very low CO2 emission



Bike steering

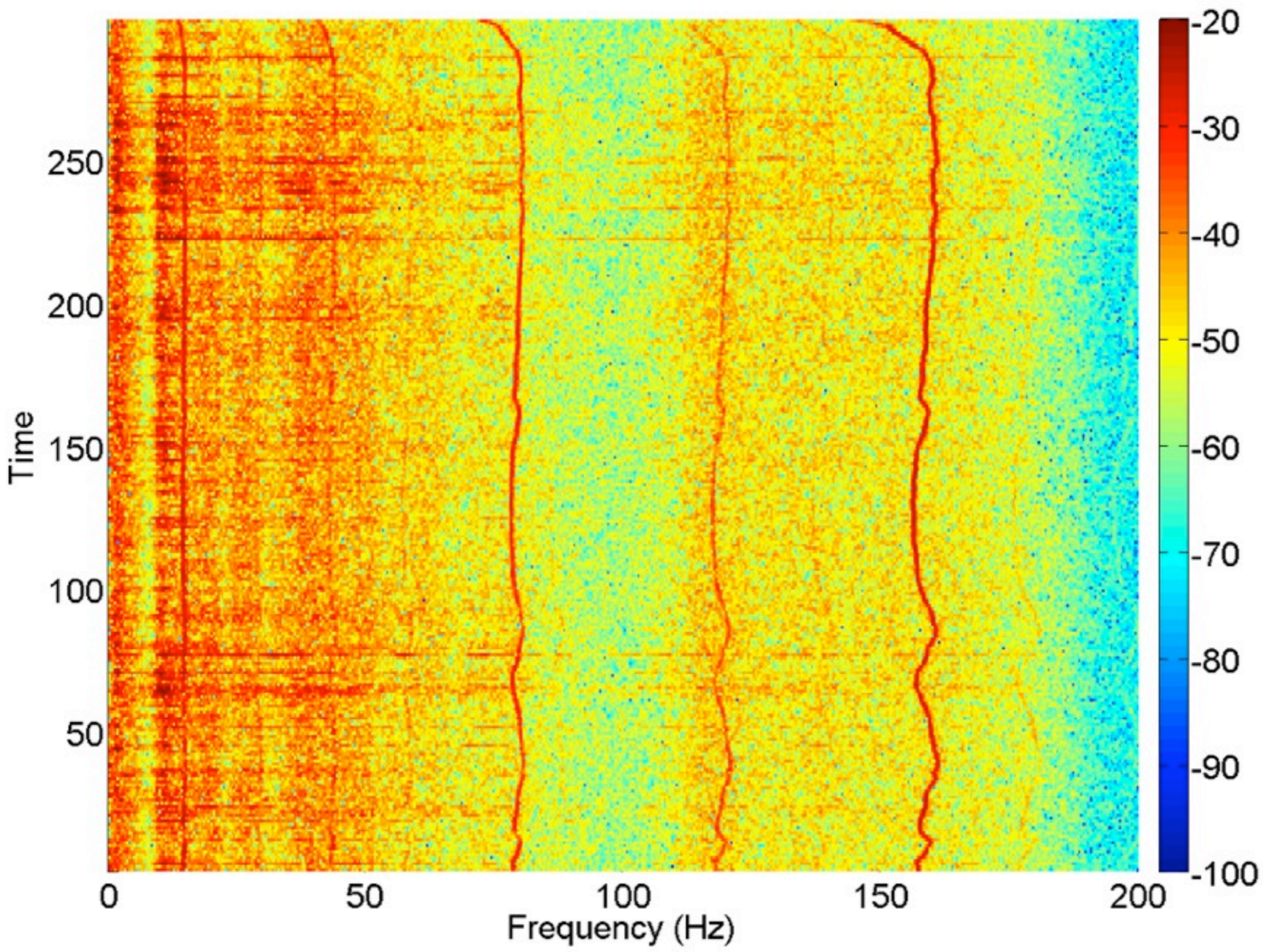


Bike steering



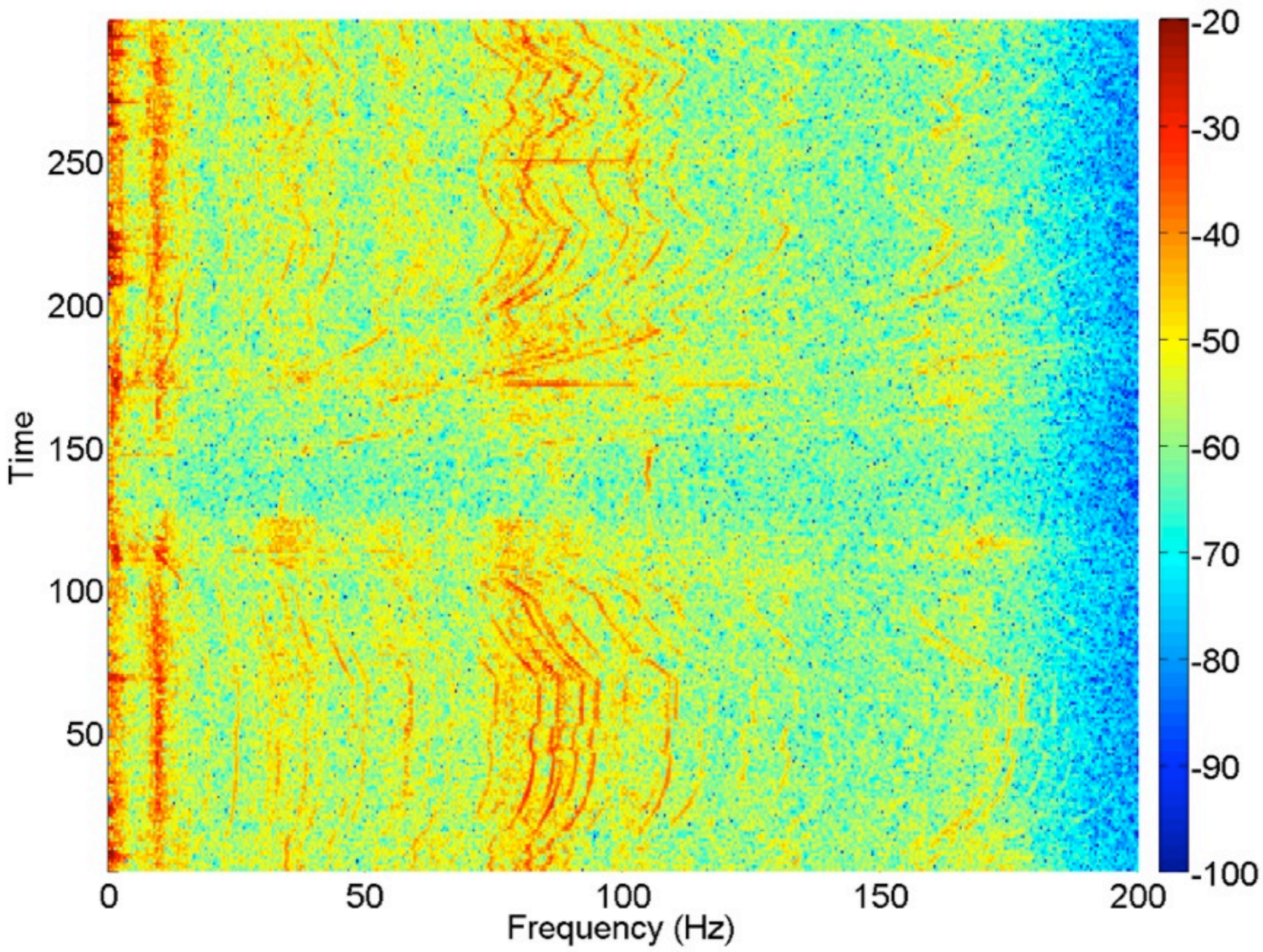


Car





Train



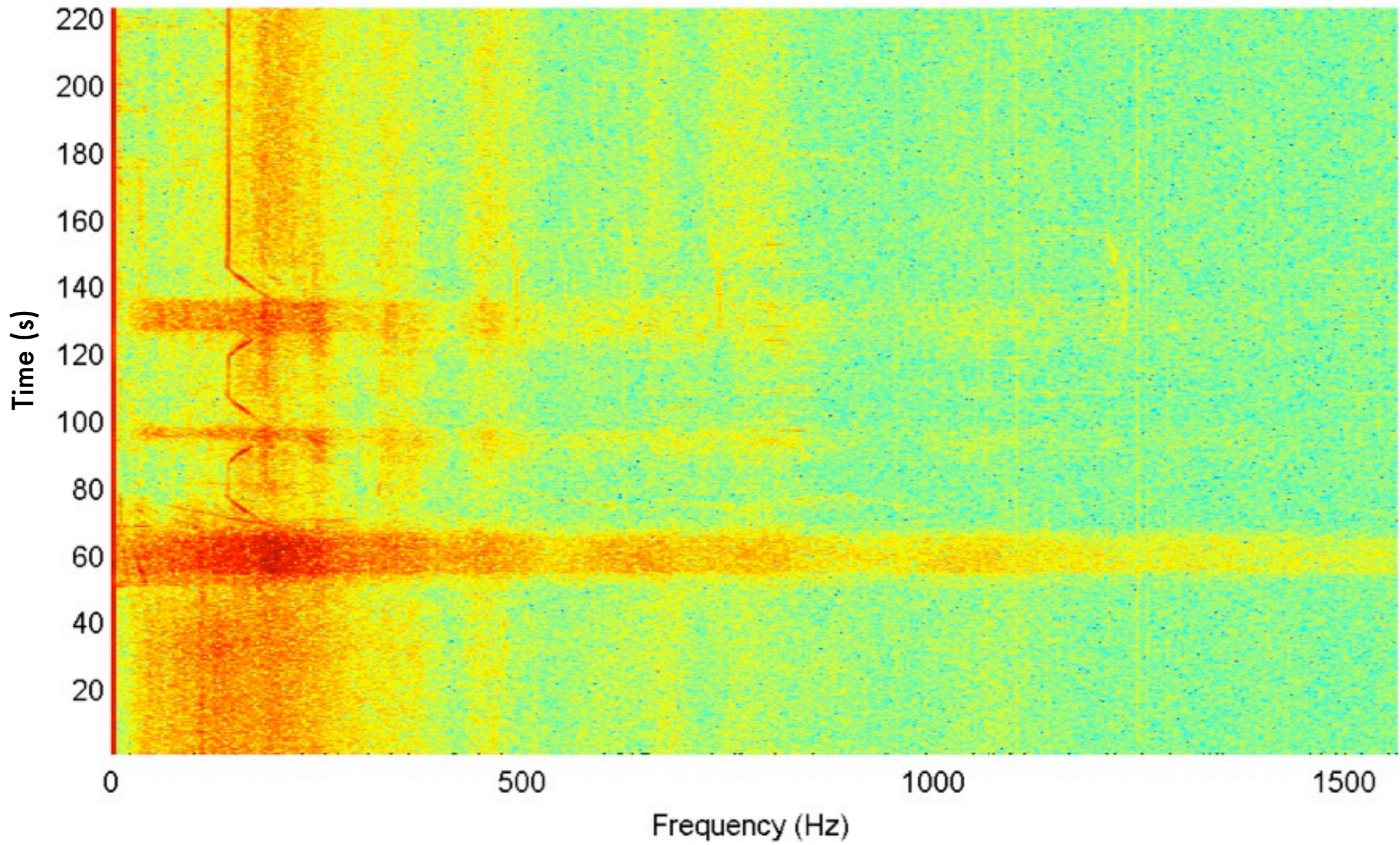


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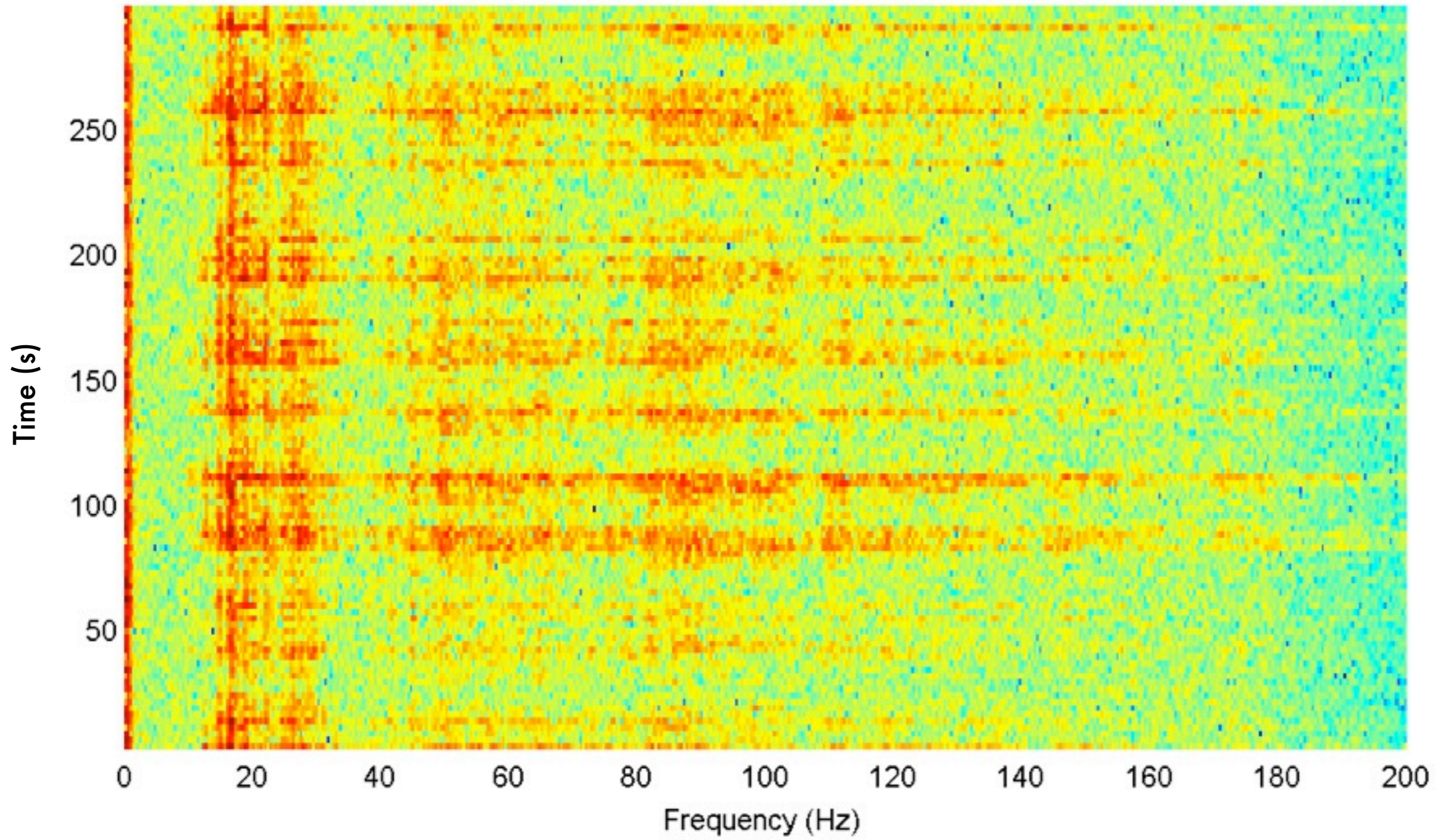


Aircraft Boeing 737



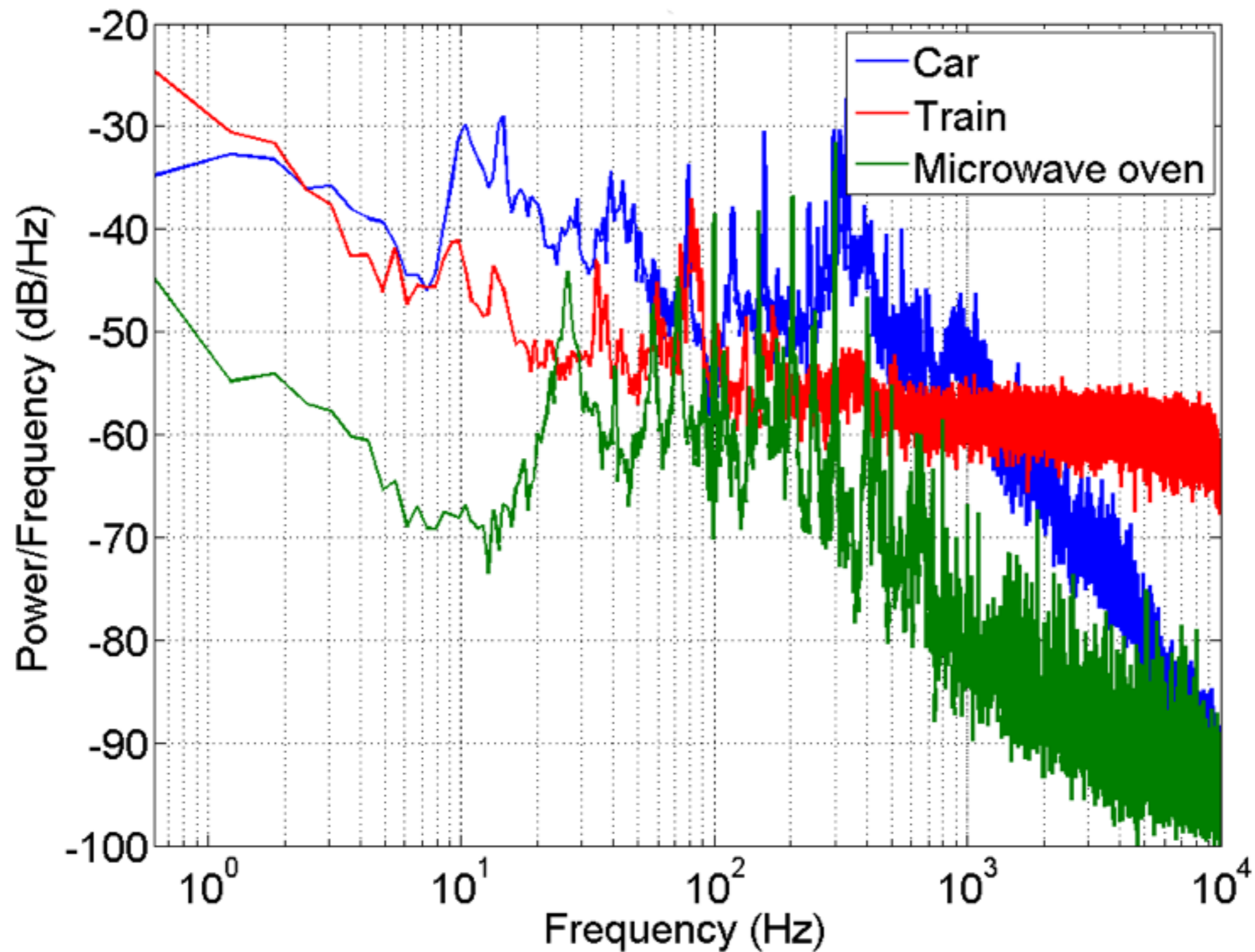


Guard rail



Energy Harvesting applications

Selected noises




Simulations

$$\begin{cases} m\ddot{x} = -\frac{\partial U(x)}{\partial x} - \gamma\dot{x} - K_v V + \xi_z \\ \dot{V} = K_c \dot{x} - \frac{1}{\tau_p} V \end{cases}$$

Simulations

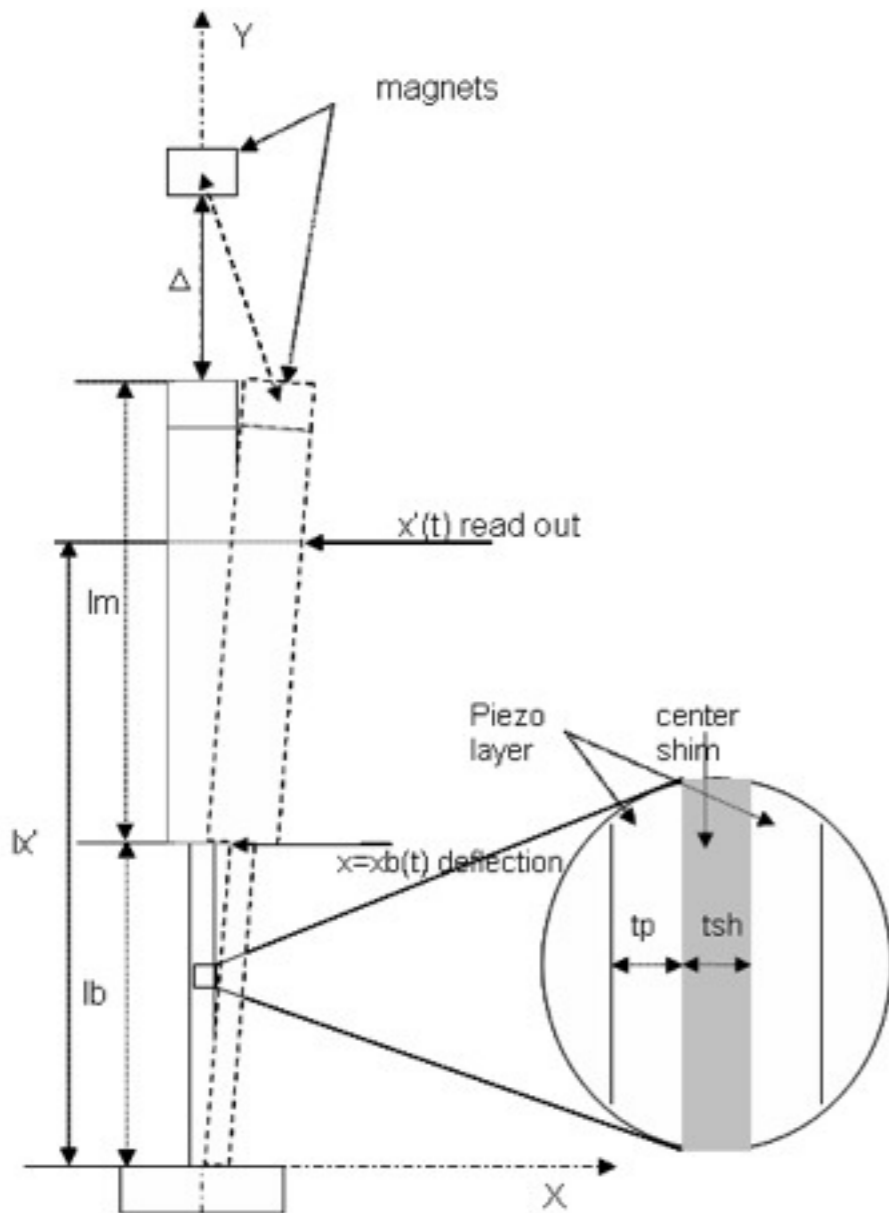
$$\begin{cases} m\ddot{x} = -\frac{\partial U(x)}{\partial x} - \gamma\dot{x} - K_v V + \xi_z \\ \dot{V} = K_c \dot{x} - \frac{1}{\tau_p} V \end{cases}$$

 **Noise from DB**

Simulations

$$\begin{cases} m\ddot{x} = -\frac{\partial U(x)}{\partial x} - \gamma\dot{x} - K_v V + \xi_z \\ \dot{V} = K_c \dot{x} - \frac{1}{\tau_p} V \end{cases}$$

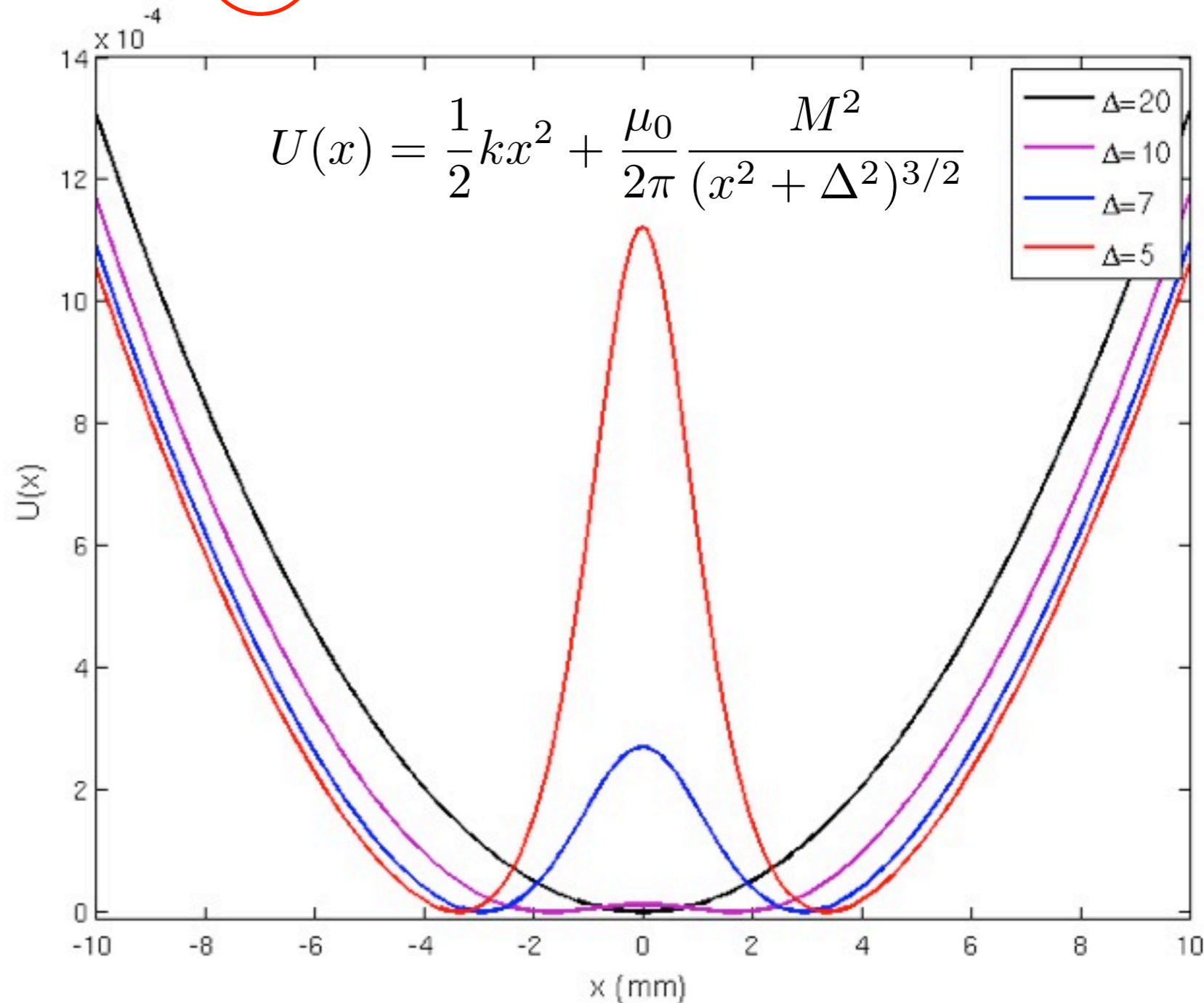
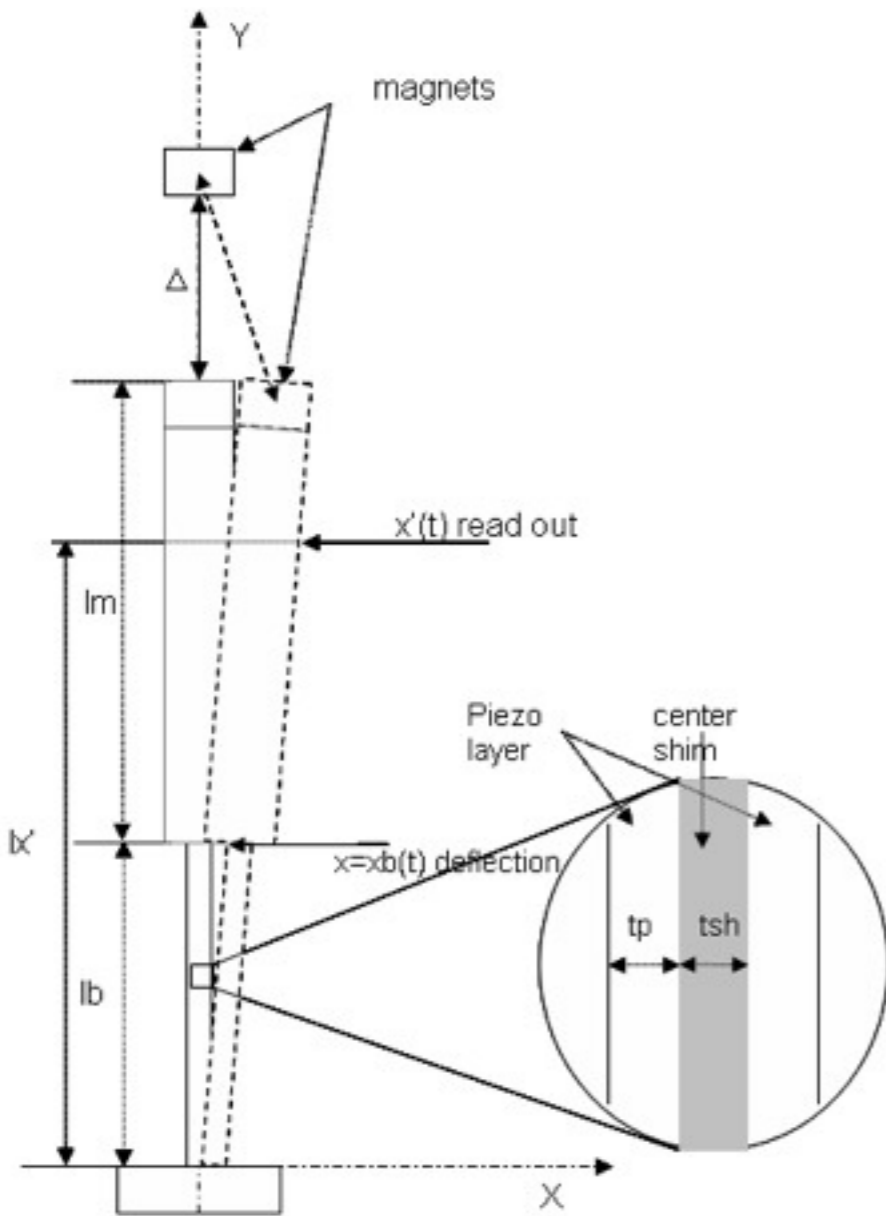
← Noise from DB

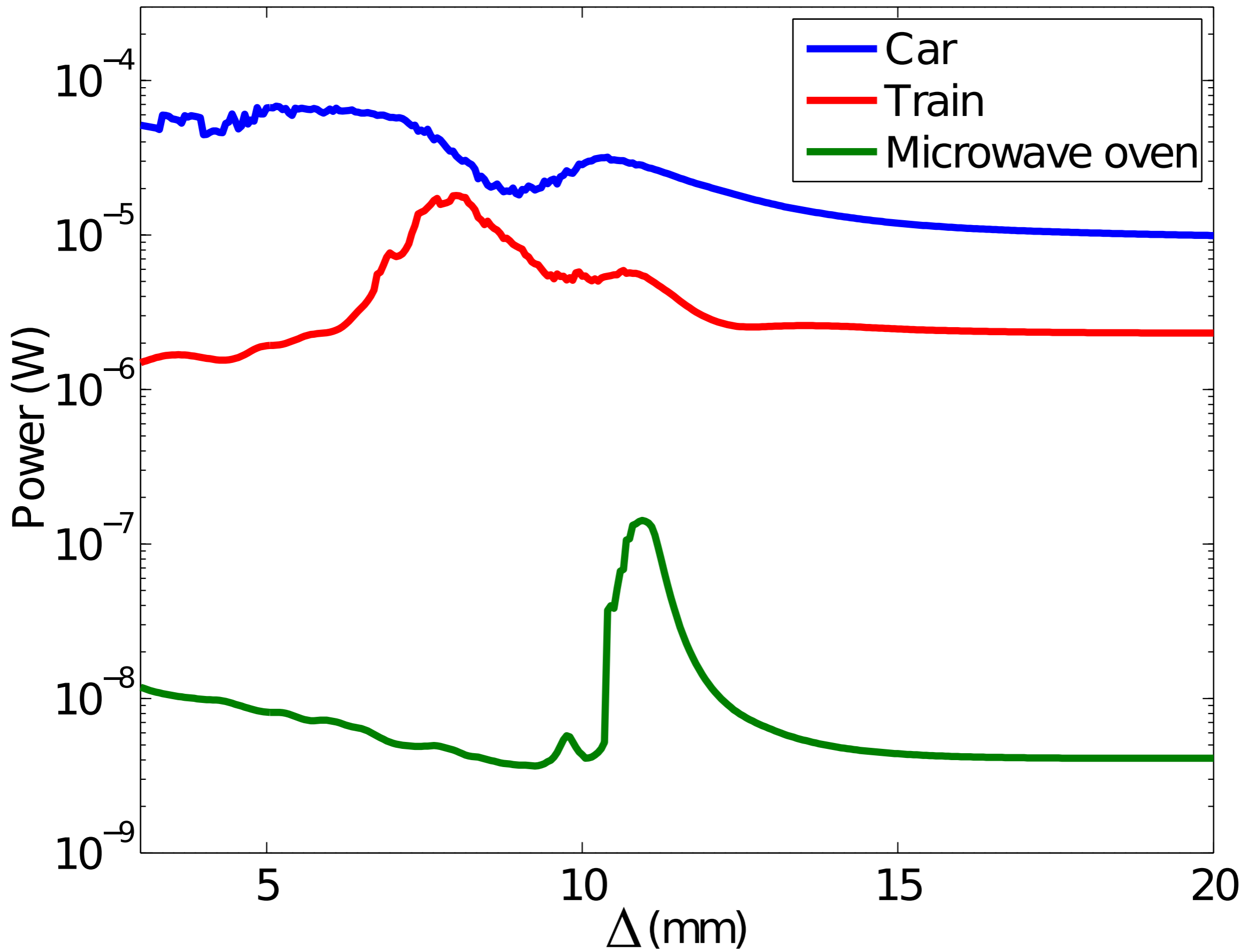


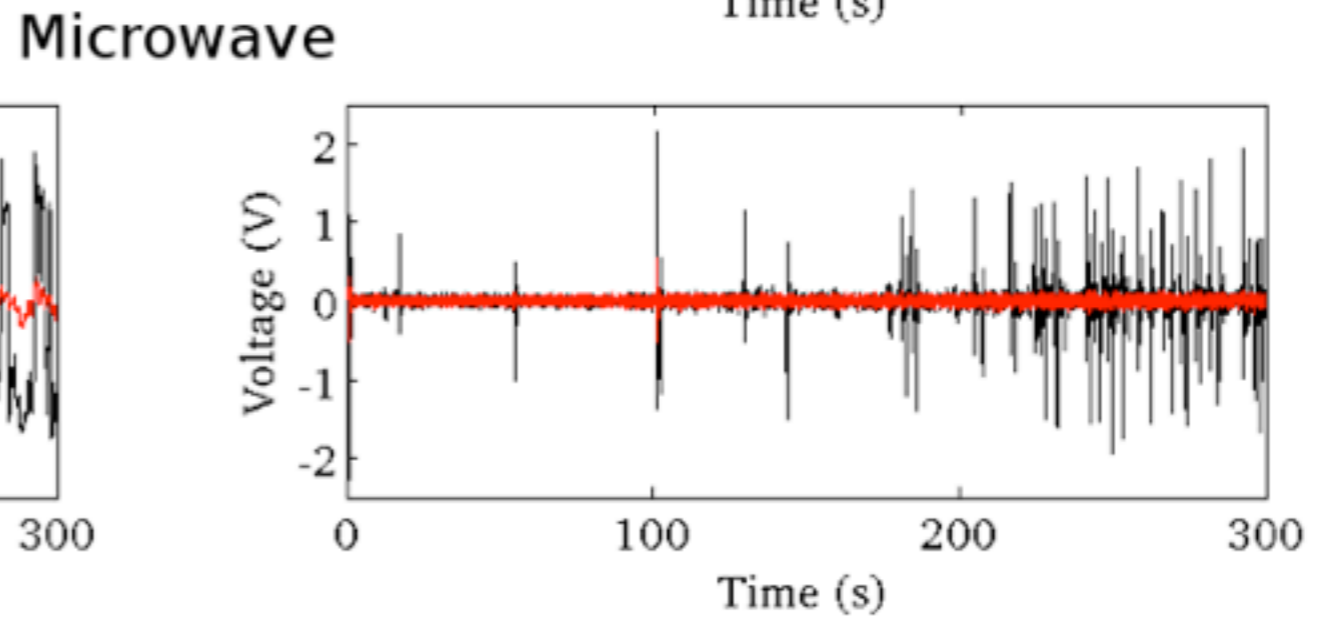
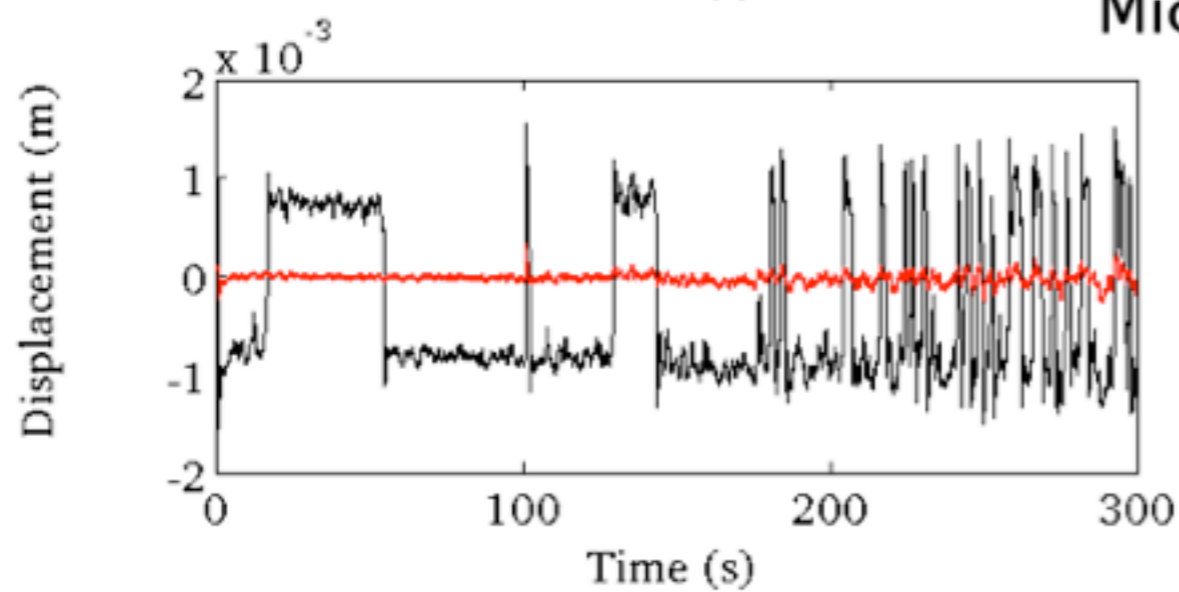
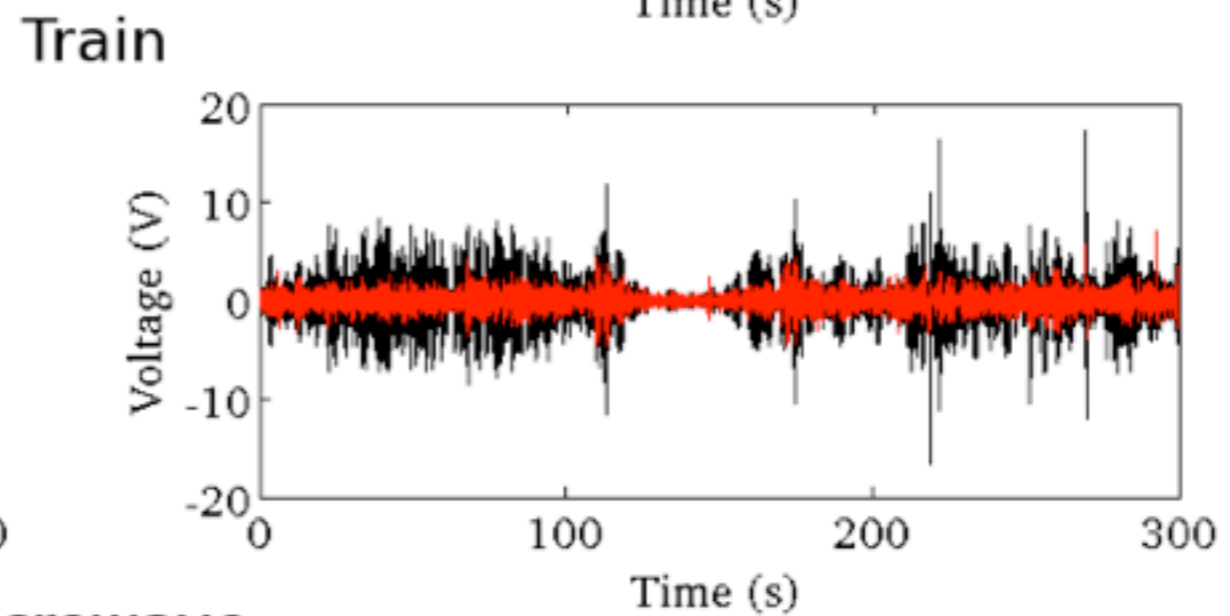
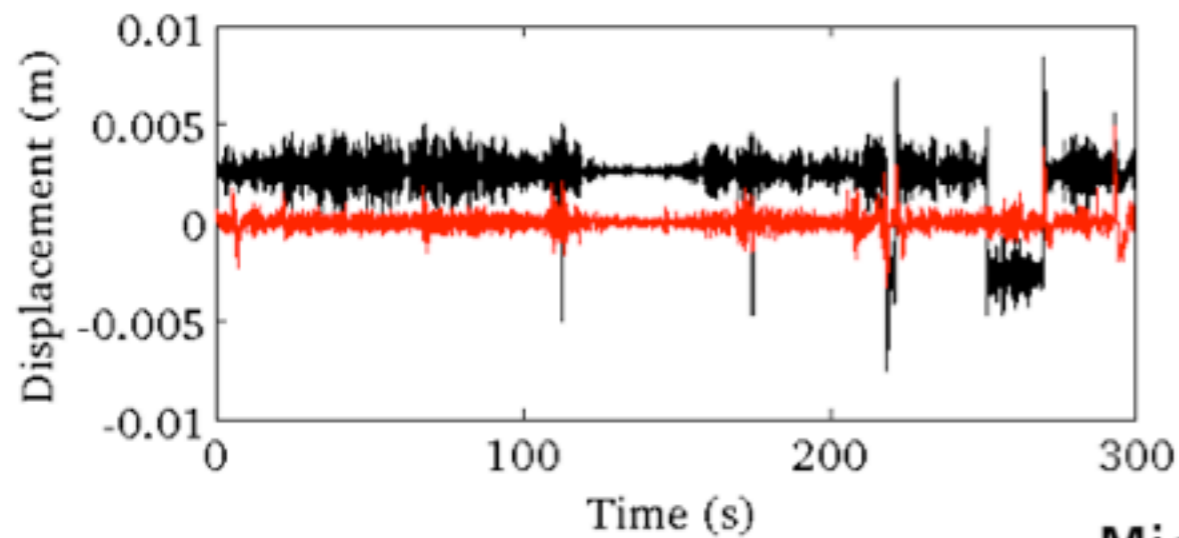
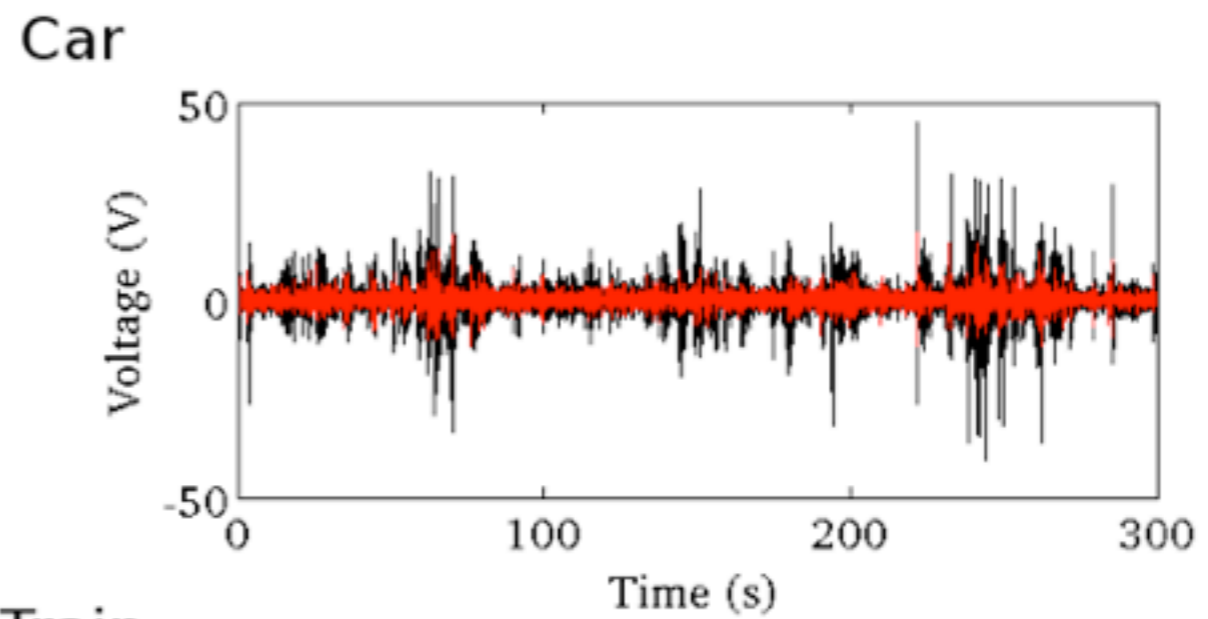
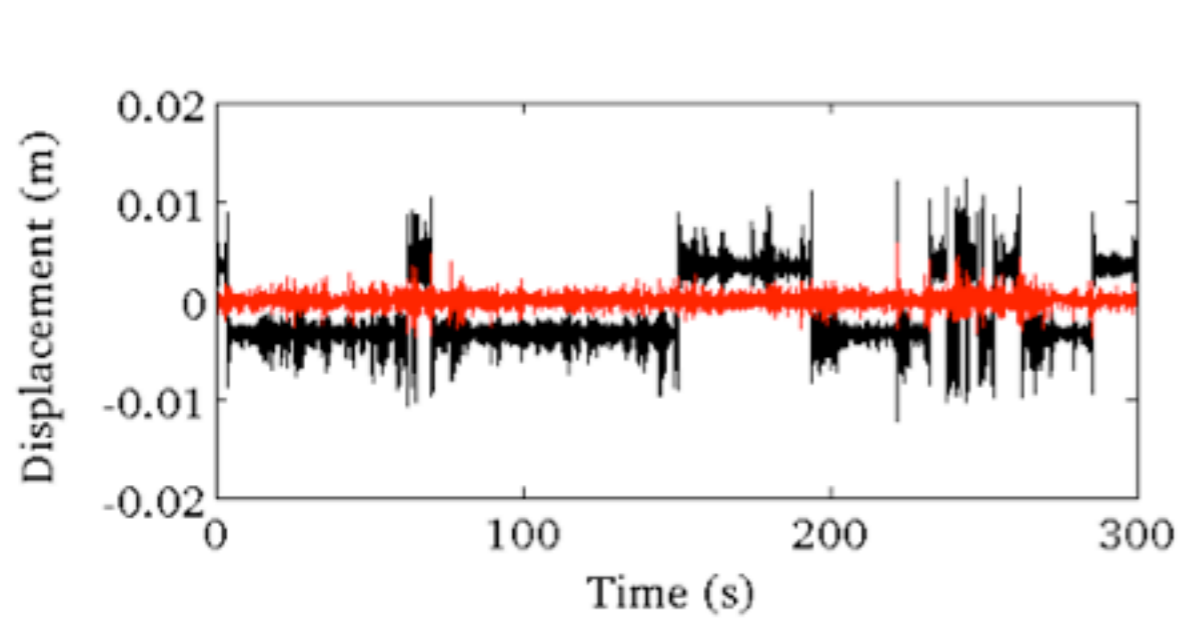
Simulations

$$\begin{cases} m\ddot{x} = -\frac{\partial U(x)}{\partial x} - \gamma\dot{x} - K_v V + \xi_z \\ \dot{V} = K_c \dot{x} - \frac{1}{\tau_p} V \end{cases}$$

← Noise from DB



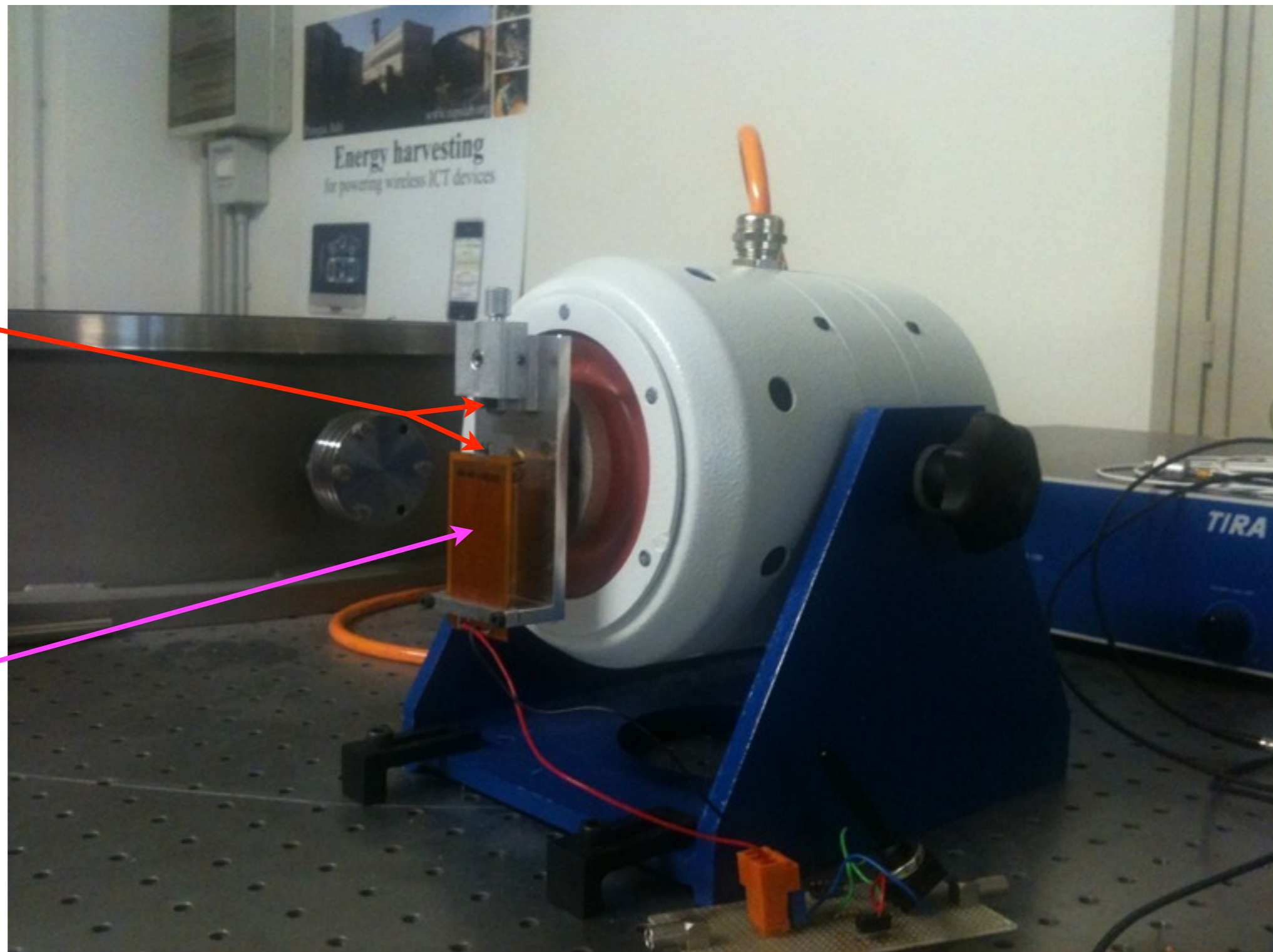


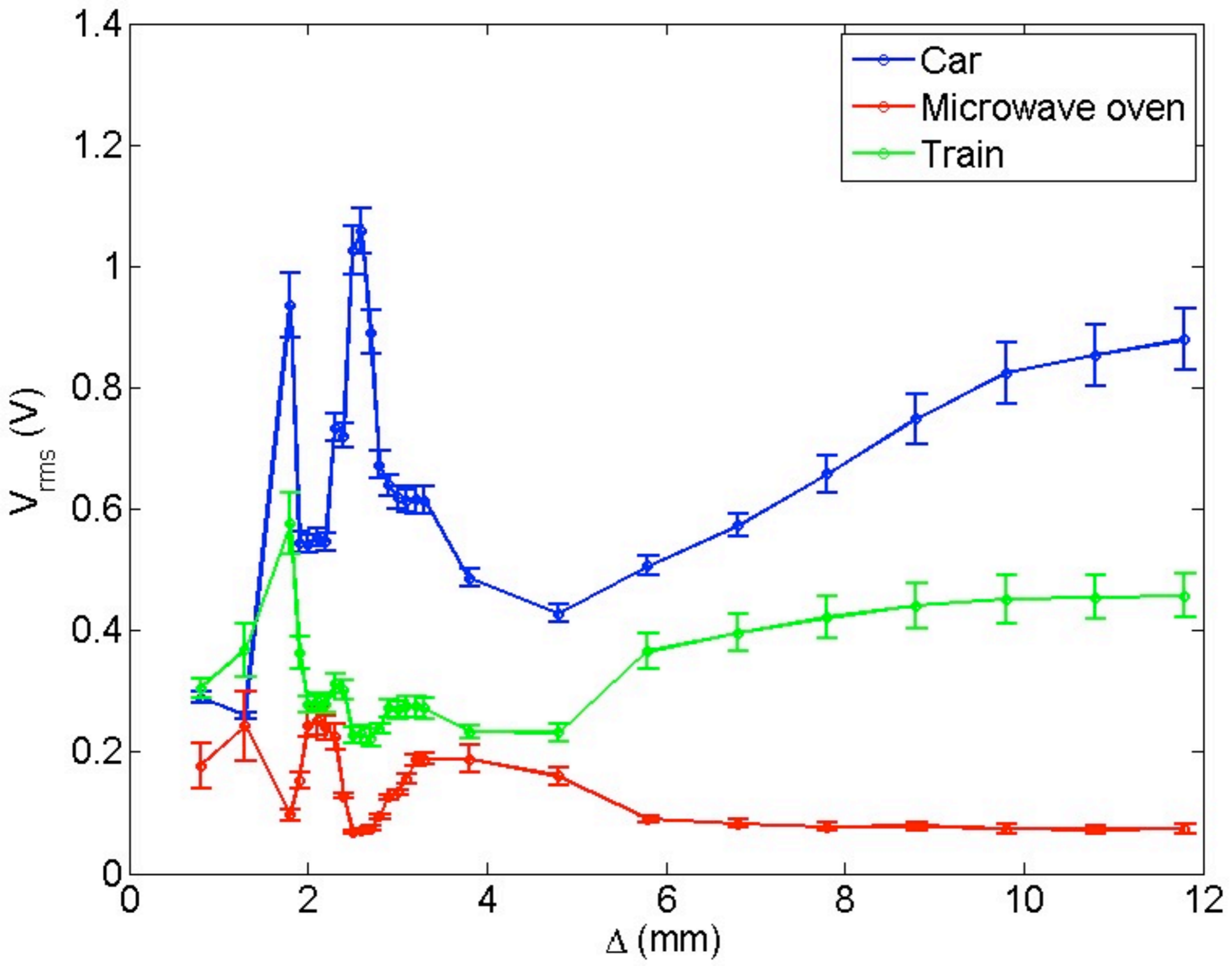


Experiment

Magnets

Piezo





Conclusions

- We developed a digital library of vibration signals
- At this time there are ~150 entry on the database
- Some test on energy harvester have been performed with selected signals from the database



Thank you for your attention

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<http://realvibrations.nipslab.org>