Real Vibrations Database

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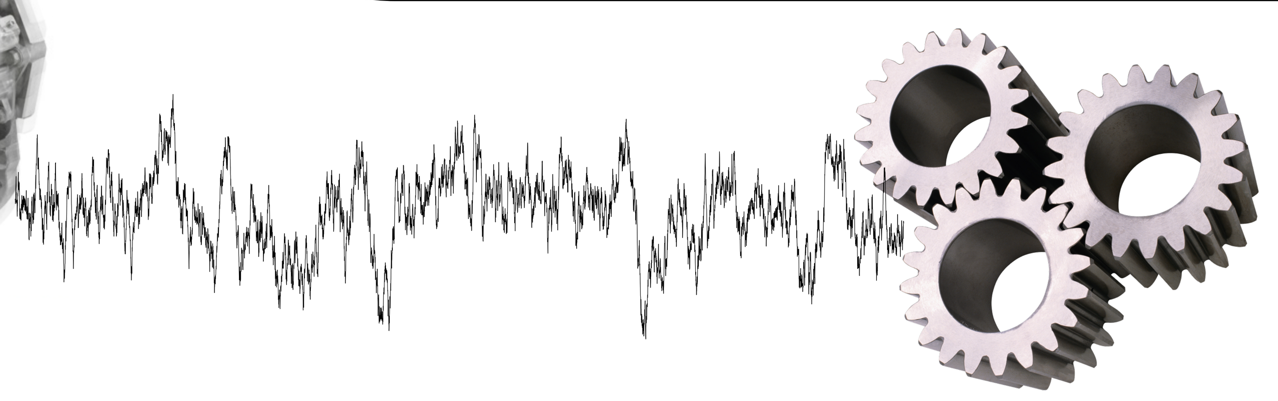
Introduction

In real world applications it is important to test energy harvesters on the field, with the real environmental vibrations, in order to improve, tune and set up all the parameters at best. During the R&D phase, this is not always possible and so laboratory tests are performed using simulated signals such as exponentially correlated noises, periodic forces or Gaussian white noises. However, such signals are a good approximation of real world vibrations only in a few specific cases. Our idea consists in collecting time series of heterogeneous vibration signals to build a large vibration database useful to the energy harvesting community.



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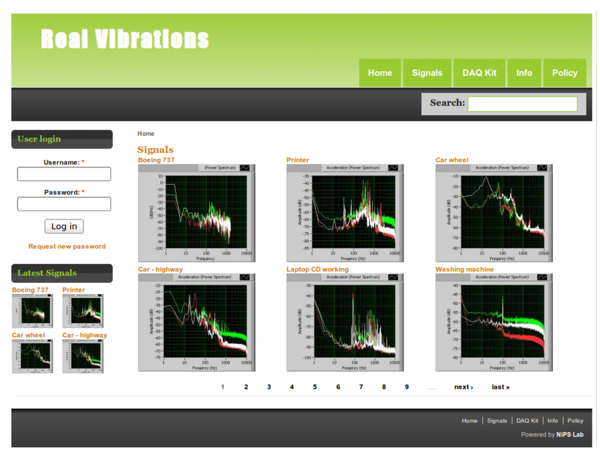
Acquisition kits

Specific need led us to use several acquisition kits that differ for size, sensibility and sampling rate.

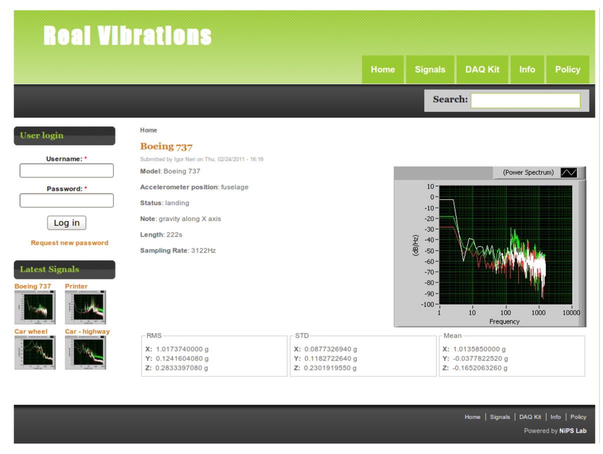
The selection of the acquisition system is based on signal spectral content, dimension constrain and portability

Database web interface



The database interface is realized using the content management system Drupal, which provides a web interface to navigate, search and download the vibration data.
The database is available at the following address: ***http://realvibrations.nipslab.org***

By selecting an entry it is possible to view the information associated with it like title, description, sampling rate, duration, acquisition conditions, RMS, standard deviation and mean for each orthogonal component. Using the search box it is possible to search through the database by keywords present on title or description. The records in the database can also be sorted out to help locate specific data more quickly.



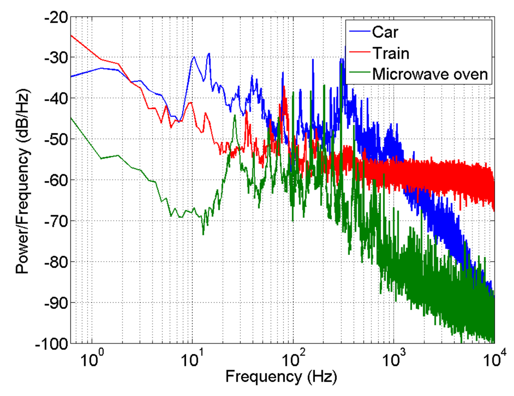
Data collection

In order to create a database with signals as close as possible to real ones few heeds must to be taken into account like expected frequency, mechanical coupling and mass ratio between the acquisition system and the vibration sources among others. The expected frequency content of a signal is the first parameter to take into account in order to determine the kit to be used and the relevant **sampling rate**, **cut-off frequency** and **acquisition time**. The **sensitivity**, or rather the resolution of an accelerometer device, is chosen in relation with the expected amplitude of the oscillations.

It is also important to evaluate how the **mounting system** influences the accelerometer. While we focus our attention on temporary mounting we used most of the time two-sides sticky tape or wax. [1]

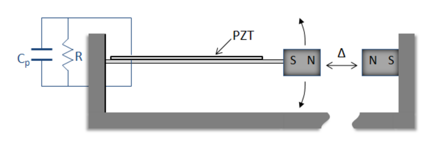
Use cases

Input noises

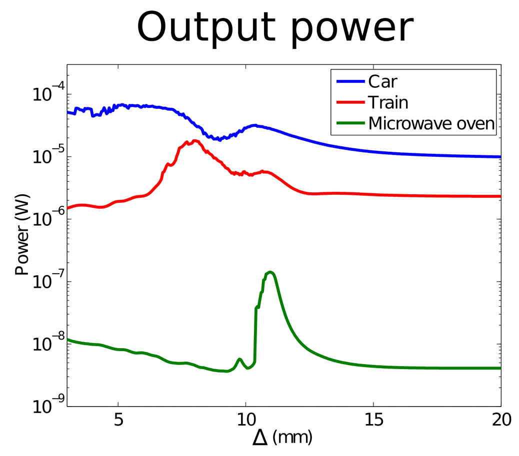


We simulated electrical power produced by a bistable harvester subjected to three noises, downloaded from the database, as function of magnets distance Δ. [2,3]

Bistable harvester



Output power



In all three cases there is a **gain in the nonlinear region** respect to the linear one (Δ ≥20 mm). The optimal distance Δ, where the maximum average power is produced, depends on the characteristic of the excitation signal. [2]

Conclusions

In this work we introduced the reasons that led us to create a database for real vibration signals, reasons mainly due to the requirements of the Energy Harvesting community. The need to test and optimize in laboratory harvesters in conditions as close as possible to the environment where these systems will operate was the main task taken into account for the choice of the data acquisition system and the mounting condition during the acquisition campaign. In order to simplify the approach to the database a web interface and a searching tool were implemented. Furthermore to have a good understanding of the characteristics of the signals a specific web page for each entry was produced. In this page the metadata, the main attributes and the frequency spectrum of the time series are displayed and briefly discussed.

Scan this QR code or visit
http://realvibrations.nipslab.org

1) **A real vibration database for kinetic energy harvesting applications,** I. Neri, F. Travasso, R. Mincigrucci, H. Vocca, F. Orfei and L. Gammaitoni, *Journal of Intelligent Material Systems and Structures*, (2012)
2) **Kinetic energy harvesting with bistable oscillators**, H. Vocca, I. Neri, F. Travasso and L. Gammaitoni, *Applied Energy*, 1/2012, (2012)
3) **Nonlinear Energy Harvesting**, F. Cottone, H. Vocca and L. Gammaitoni, *Physical Review Letters*, 02/2009, Volume 102, Issue 080601, (2009)