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# INTRODUCING A HOMEPAGE FOR INFORMATION RETRIEVAL AND BACKUP OF GROUND VIBRATION MEASUREMENTS AND MECHANICAL VIBRATIONS OF SUPERCONDUCTING MODULES AT DESY

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**Abstract**

In this paper, 'http://vibration.desy.de', used as a tool for the storage and dissemination of ground motion measurement database of 20 sites around the world and the vibration stability data of superconducting modules for the European X-ray Free Electron Laser (XFEL) and the proposed International Linear Collider (ILC) is introduced. This homepage is open to the scientific community and the data can be utilized for planning of future accelerator facilities and design of future prototypes of module vessels containing cold mass.

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*Abstract*

In this paper, 'http://vibration.desy.de', used as a tool for the storage and dissemination of ground motion measurement database of 20 sites around the world and the vibration stability data of superconducting modules for the European X-ray Free Electron Laser (XFEL) and the proposed International Linear Collider (ILC) is introduced. This homepage is open to the scientific community and the data can be utilized for planning of future accelerator facilities and design of future prototypes of module vessels containing cold mass.

## MOTIVATION

The ground vibrations measurement database of DESY is unique and first of its kind as it contains data of 20 sites around the world including both, high energy laboratory sites and synchrotron radiation facilities [1]. The measurements for this database were performed from 2003 to 2006 and are therefore, recent. The superconducting modules (cryomodules) vibration data have been collected since 2006 and currently comprise of data on mechanical stability of Type II and III cryomodules, at room temperature [2]. As the data volume increased to a few TB, it was decided to make this data accessible to the worldwide scientific community via a homepage [3].

The version described here has been completely redesigned with ZMS [4] which is an open source ZOPE [5] based content Management System for science, technology and engineering, using the DESY design templates to comply with corporate identity policies. ZOPE stands for "Z Object Publishing Environment". This homepage uses the Andrew File System (AFS) [6] to store the entire database. In this way, it acts as a data backup tool. In addition, it assures ease of navigation and data retrieval through its tree structure since by utilizing the homepage, users do not need to login to the DESY AFS network.

## TECHNICAL ASPECTS

This section contains a short introduction to the technical aspects of the homepage. The homepage is fully compatible with many browsers such as Internet Explorer 6.0, Windows Firefox 1.0, Linux Firefox 1.0.7, Mozilla 1.7, Mac Mozilla 1.7.12, Netscape 7.2, Safari 2.0 and higher. However, other browsers should not impose any problems, although they have not been tested.

### *About AFS*

AFS is a distributed file network protocol developed by the Carnegie Mellon University. It is used to store files within a network of computers, hence the term distributed file system, but makes them available on every machine, just as easy as local files. Having a uniform namespace, it is sufficient for the user to know the path and filename, which of course is the same for every user, without needing to know where exactly a file is stored within the network.

This distribution is done by grouping files and folders into volumes (in this case ~ 8 GB per volume). These volumes are objects containing folders, files and mountpoints (links to other volumes), to create another layer between the visible path and the physical position of the data on the servers. The advantage of this system is that volumes can be moved to other machines and discs, while they are being used. This is possible since several read-only copies of volumes can be created without the user ever knowing which one is being accessed at the moment. Administrators and Information Technology (IT) personnel can work in the background to maintain the machines at peek efficiency and exchange faulty hard disc drives without any performance loss.

Data upload to the AFS is done with the client software, WinSCP [7]. It has a Norton Commander (or Explorer-like) interface for easy use, since no command line inputs are necessary.

### *Zipping*

All available data are compressed to significantly reduce their size by a compression factor of about 4 to 6. Compression is performed by a freeware tool called 7-zip [8] and is done in a zip format. 7-zip is used to ensure full compability with both Windows and Linux systems. The database contains up to now about 350 GB (~ 2 TB, uncompressed) zipped data, not exceeding a maximum of 1 GB of compressed data per individual file.

### *ZMS*

ZMS is a ZOPE based open source content management system used to create the backbone of this homepage. This content management system is used to facilitate design, layout and to remain up-to-date with the latest color and layout scheme of the DESY homepage template. Therefore, the homepage does not need to be updated manually when the template is updated.

## DESIGN ASPECTS

### *Homepage Layout*

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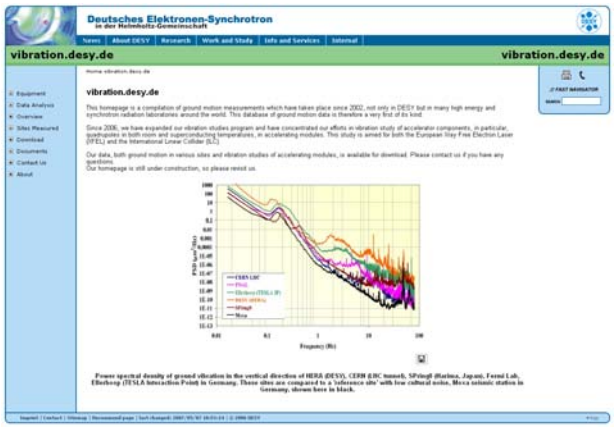


Figure 1: Screen capture of the introduction page.

The homepage, having a tree structure, is divided into several major sections (see Fig. 1).

- Equipment: This section contains a brief technical overview of the equipment used for measurements together with their photographs. For long term or precision measurements, three GÜRALP broadband seismometers were used. Geophones manufactured by Geospace Technologies and SENSOR, were used for short 'snapshot' measurements. This section also contains links to the manufacturers' homepages for further information.
- Data Analysis: In this section, a description of the techniques used to analyse seismic measurements, such as fast Fourier transformation, as well as a table with the sensor calibration constants are provided.
- Overview: This section is relevant to the ground motion database only. It displays all measured sites in a tabular format for ease of reference (see Fig. 2).
- Sites measured: This section comprises of detailed description about the sites measured and the cryomodule experimental set up.
- Download: All measured data, whether raw or processed, are available here for download.
- Documents: Here, one can find several presentations and publications on the results obtained.
- Contact Us: e-mail addresses of the persons responsible for the homepage are given.
- About: This is the credits page.

The homepage also contains a DESY legal notice which includes a 'disclaimer', 'conditions of use' and copyright information. The sections 'Overview', 'Sites Measured' and 'Download' are explained further in the following subsections.

## *Overview*

The overview table, Fig. 2, compares all measured sites for their level of 'cultural noise' (e.g. traffic, industry) [1]. It shows the year/s in which the measurements took place and the calculated attributes for each site, such as the average root mean square (rms) of ground vibrations in vertical direction, including day and night variations and Peak-to-Peak vibration values.

The entries in the table are color coded, in black, green or red to mark the level of 'cultural noise' for each site. Red signifies high level, average rms > 50 nm. Black sites have an average rms of 10-30 nm and green sites an average rms vibration of less than 10 nm.

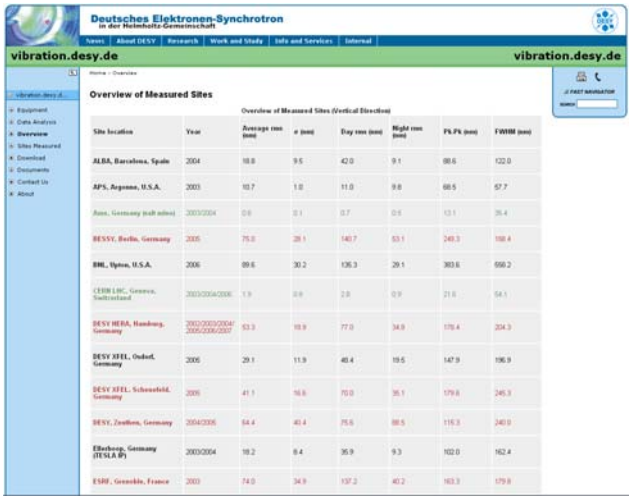


Figure 2: Screen capture of the overview table (partially displayed).

## *Sites Measured & Cryomodule Data*

The 'Sites Measured' section displays the names of all the sites measured in alphabetical order. Cryomodule vibration data are included as one of the items in this menu. In the case of ground vibration measurements for a site, a short description of the 'cultural noise' situation of a site is followed by a detailed description of the sensor position for each measurement. Google Maps [9] (not yet available, at the time of writing, for the Chinese sites measured in this homepage), which can be switched from a map-view to a satellite or a hybrid view (showing both), may provide the user additional information of the described 'cultural noise' situation in the surrounding area or at the site. Additionally, photographs taken of each measurement, showing the exact sensor position and the surrounding areas, are also available.

Every item (measured site) contains an AFS link to the data of that site, at the bottom of its corresponding page, and the user can download straight from here. Moreover, maximum and minimum levels of 'cultural noise' for each given site are selected from the data set and can also be downloaded.

For the cryomodule vibration data, a detailed description of the sensor positions, dates of the measurements and photographs of the sensor positions are provided (see Fig. 3).

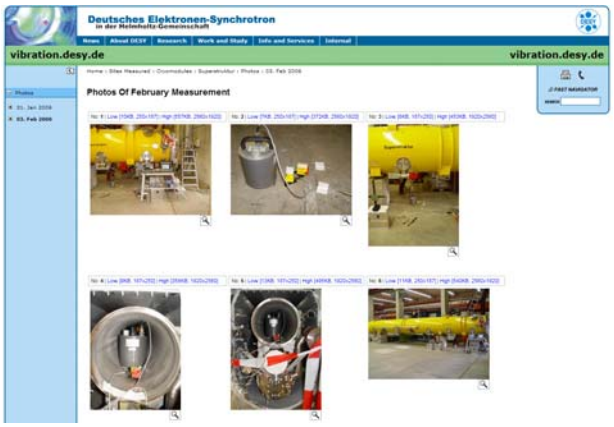


Figure 3: Screen capture of a cryomodule experimental set up.

Each site and cryomodule item contains comprehensive spectra ranging from rms versus time, to monitor fluctuations in vibration levels with time, displacement Power Spectral Density (PSD) for each site compared to two reference sites HERA and seismic station Moxa in Germany and their corresponding integrated PSD, and plots of selected data (as explained above) for the highest and lowest levels of 'cultural noise' for each site (both PSD and integrated). All spectra are downloadable as high resolution Portable Document Format (PDF) files (see Fig. 4).

In the case of the cryomodule data, PSD (and integrated PSD) plots for various components within the module, such as vacuum vessel top versus quadrupole and the corresponding transfer function are given. For a definition of transfer function, see [2].

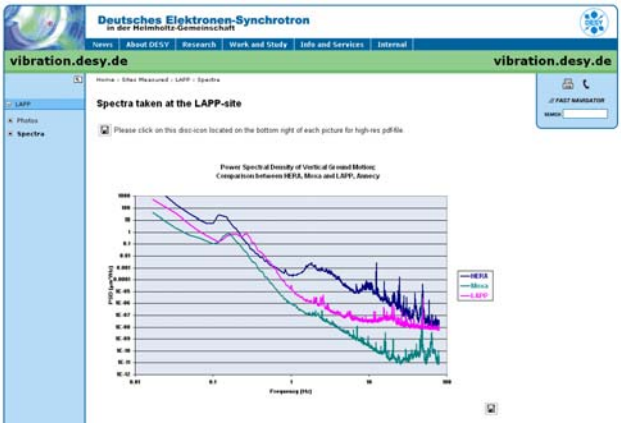


Figure 4: Screen capture of one of the measured spectra pages.

### *Download*

This section is the interface to the AFS system. All measurement data are shown as a tree structure for easy navigation. Raw data (unprocessed files, with/without local time correction) are available for download. Users can utilize their own analysis programs to analyse these files. Fully processed Fast Fourier Transformed data in all directions (vertical, and two horizontal) can be viewed via a display program [10]. This program can be downloaded together with Accelerator Component Oriented Programming tools (ACOP) [11] from the link provided in the homepage. Data file structure and a table of sensor calibration constants is also available in this section.

## SUMMARY

http://vibration.desy.de proves to be a very useful communication, data backup and retrieval tool for the ground vibration database and vibration stability of the XFEL/ILC cryomodule data at DESY. It is envisaged that the database of the cryomodule stability will be expanded to include mechanical stability data at cryogenic temperatures.

## ACKNOWLEDGMENTS

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[2] R. Amirikas, A. Bertolini, W. Bialowons, "Vibration stability studies of a superconducting accelerating module at room temperature", these proceedings.
[3] The first version of the homepage was created by Heiko Ehrlichmann and Hannes Molsen.
[4] http://www.zms-publishing.com/index_eng.html
[5] http://www.zope.org
[6] http://www.openafs.org
[7] http://winscp.net
[8] http://www.7-zip.org
[9] Google Maps™ terms of use: http://www.google.com/apis/maps/terms.html
[10] Written by H. Ehrlichmann.
[11] http://adweb.desy.de/mst/acop