



Update Article

Updating dataset of measurements for the experimental CEA-beam benchmark structure subjected to one stochastic broadband excitation *with* dataset of measurements for the CEA-beam system subjected to two correlated or uncorrelated broadband random excitations[☆]



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[☆] Refers to T. Roncen, J-P. Lambelin, Y. Chantreau and J-J. Sinou, Dataset of measurements for the experimental CEA-beam benchmark structure subjected to one stochastic broadband excitation, Data in Brief, 35, 106798, 2021.
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ABSTRACT

This data article comprises data to investigate the non-linear dynamic behavior of the beam benchmark structure that is a clamped-clamped steel beam with non-ideal boundary conditions subjected to two broadband correlated or uncorrelated random excitations. Experiments have been performed on the CEA-CESTA laboratory.

The data provided include output measurements for the non-linear dynamic behavior of the CEA-beam (i.e., the accelerations amplitudes for the three accelerometers on the beam), as well as the two input forces amplitudes. In comparison with the data provided in [4] which only considers the

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Keywords:

Nonlinear vibration
 CEA-beam benchmark structure
 Correlated and uncorrelated broadband
 random excitations
 Non-ideal boundary conditions

case of a single excitation, experimental results are extended for the CEA-beam system subjected to two correlated or uncorrelated broadband random excitations. All the results from this data will help researchers and engineers in proper analysis of the nonlinearities of the clamped-clamped beam and the effects of the correlation between two broadband correlated or uncorelated random excitations on the nonlinear signature of this academic structure. One of the main original contributions is to share the data sets to give the opportunity to researchers for testing and validating analytical or numerical models of a nonlinear beam with non-ideal boundary conditions and subjected to multipoint correlated or uncorrelated random excitations. This Data in Brief article is an additional item directly alongside the following paper published in the Elsevier journal: S. Talik, J.-J. Sinou, M. Claeys and J.-P. Lambelin, *Nonlinear vibrations of a beam subjected to two broadband correlated or uncorrelated broadband random excitations - experiments, modeling and simulations*, Communications in Nonlinear Science and Numerical Simulation, 106328, 2022.

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Specifications Table

Subject	Mechanical engineering
Specific subject area	Structural vibration, multipoint correlated and uncorrelated random excitations, nonlinear vibration, beam system.
Type of data	Tables, figures, *.mat files and *.txt ASCII files
How the data were acquired	All the dynamic signal generation and acquisition are performed via the data acquisition platform Simcenter Testlab software from Siemens, and more specifically the MIMO Random module, that control the timing, synchronization, and data transfer between the Sensor-Based Input/Output modules and the external host
Data format	Raw data
Description of data collection	The data gives PSD of acceleration of the CEA-beam structures for three accelerometers for on a frequency band [20 - 1000 Hz] for four types of correlation and PSD of both forces applied to the CEA-beam
Data source location	Data obtained from the CEA/CESTA laboratory, CS60001, 15 avenue des Salinières, 33116 Le Barp, France
Data accessibility	Repository name: Mendeley Data Data identification number: doi: 10.17632/8bs26jgxv6.1 Direct URL to data: https://data.mendeley.com/v1/datasets/8bs26jgxv6/1
Related data article	T. Roncen, J.-P. Lambelin, Y. Chantereau and J.-J. Sinou, Dataset of measurements for the experimental CEA-beam benchmark structure subjected to one stochastic broadband excitation, Data In Brief, 35, 106798, 2021. doi: 10.1016/j.dib.2021.106798
Related research article	This data is supplementary to S. Talik, J.-J. Sinou, M. Claeys and J.-P. Lambelin, Nonlinear vibrations of a beam subjected to two broadband correlated or uncorrelated broadband random excitations - experiments, modeling and simulations, Communications in Nonlinear Science and Numerical Simulation, 106328, 2022.

Value of the Data

- The database provides response measurements (for each accelerometer) for the experimental CEA-beam benchmark structure subjected to two broadband correlated and uncorrelated random excitations.
- The data could be useful for researchers and industrial in understanding of the nonlinear bending behavior of a beam subjected to multipoint correlated or uncorrelated random excitations. The database gives the opportunity to researchers for comparing and validating analytical and numerical models for predicting the nonlinear dynamic behavior of a clamped-clamped steel beam with non-ideal boundary conditions and subjected to multipoint correlated or uncorrelated random excitations.

1. Data Description

This dataset is provided as supplementary data in a Matlab format *.mat and ASCII format *.txt.

The data are provided as follows: there are eight files (eight in a Matlab format *.mat and eight in a ASCII format *.txt) corresponding to two experiments named '*Experiment1*' and '*Experiment2*' as described in the related research article [1] and reminded in the following section. Each experiment corresponds to four files corresponding to each multipoint random excitations i.e., to two broadband correlated random excitations in phase (file named '*Experiment1_InPhase*' or '*Experiment2_InPhase*'), to two broadband correlated random excitations in opposite phase (file named '*Experiment1_OppositePhase*' or '*Experiment2_OppositePhase*'), to two broadband correlated random excitations in quadrature phase (file named '*Experiment1_QuadraturePhase*' or '*Experiment2_QuadraturePhase*') and to two broadband uncorrelated random excitations (file named '*Experiment1_Uncorrelated*' or '*Experiment2_Uncorrelated*'). Each file is described as follows: there are five columns corresponding to the input frequency (Hz), the Power Spectrum Density of the force of each electrodynamic shakers (force sensors F1 and F2 : KISTLER, ref. 9301A) during experiments for each experiment and each correlation type, and the Power Spectrum Density of accelerations for each accelerometer A1, A5 and A6 (sensor A1 : ENDEVCO ref. 66M5; sensors A5 and A6 : PCB ref. 356A01) during experiments for each experiment and each correlation type. Descriptions of the columns headings for these files are provided in Table 1.

Each column describes a channel output or input measurement produced for a specific acquisition frequency as described in Table 1.

Table 1

Description of the dataset for *.txt and *.mat files.

Column	Signal	Quantity	Unit
1	Input/Output	Frequency	Hz
2	Input	PSD of force amplitude 1	N ² /Hz
3	Input	PSD of force amplitude 2	N ² /Hz
4	Output	PSD of acceleration A1	g ² /Hz
5	Output	PSD of acceleration A5	g ² /Hz
5	Output	PSD of acceleration A6	g ² /Hz

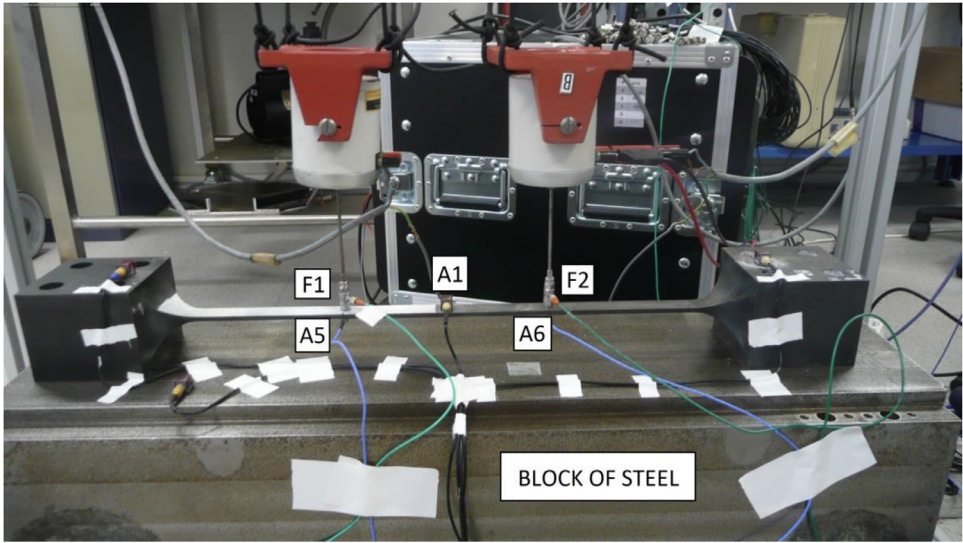


Fig. 1. Experimental CEA-beam with three Accelerometers (A1, A5, and A6) and two cell forces (F1, F2) related to the two electrodynamic shakers (modified from [1]).

Table 2
Physical parameters of the CEA-beam.

Parameter	Unit	Value
Length	mm	470
Thickness	mm	5
Width	mm	20
Young modulus	GPa	210
Density	kg/m ³	7800

2. Experimental Design, Materials and Methods

The CEA-beam benchmark structure consists of a beam and two blocks made from a single piece of steel, as shown in Fig. 1.

The technical drawing of the CEA-beam benchmark structure is given in Fig. 2. All the physical parameters are also given in Table 2. This CEA-beam is bonded to a heavy steel block of dimensions 100 × 100 × 85 mm³. To be noted that the CEA-beam structure is composed of one beam plus two massive blocks at each end in order to avoid undesirable non-linear phenomena. As shown in Fig. 2, a smooth transition between the beam and each block exists leading to model the CEA-beam system with non-ideal boundary conditions (see [2,3] for more details). The entire structure (i.e. the beam plus the two blocks) is bolted to a heavy steel block.

The system is instrumented with one three-dimensional accelerometer (A1), placed at the center of the beam (x = 0 m, considered as the origin of the experimental system) and two one-dimensional accelerometers (A5, A6) (respectively placed at x = -0.10 m and x = +0.10 m) as depicted in Fig. 1. Two other three-dimensional accelerometers are positioned on the two massive ends of the CEA-beam and one other three-dimensional accelerometer is positioned on the massive block of steel to reassure the correct embedding of the beam (to be noted that the experimental data of these three last accelerometer sensors not provided). Each provided data correspond to the vertical displacement of the beam.

The following paragraph briefly describes the experimental protocol. The beam is subjected to a bi-points random excitation by two electrodynamic shakers (respectively placed at x = -

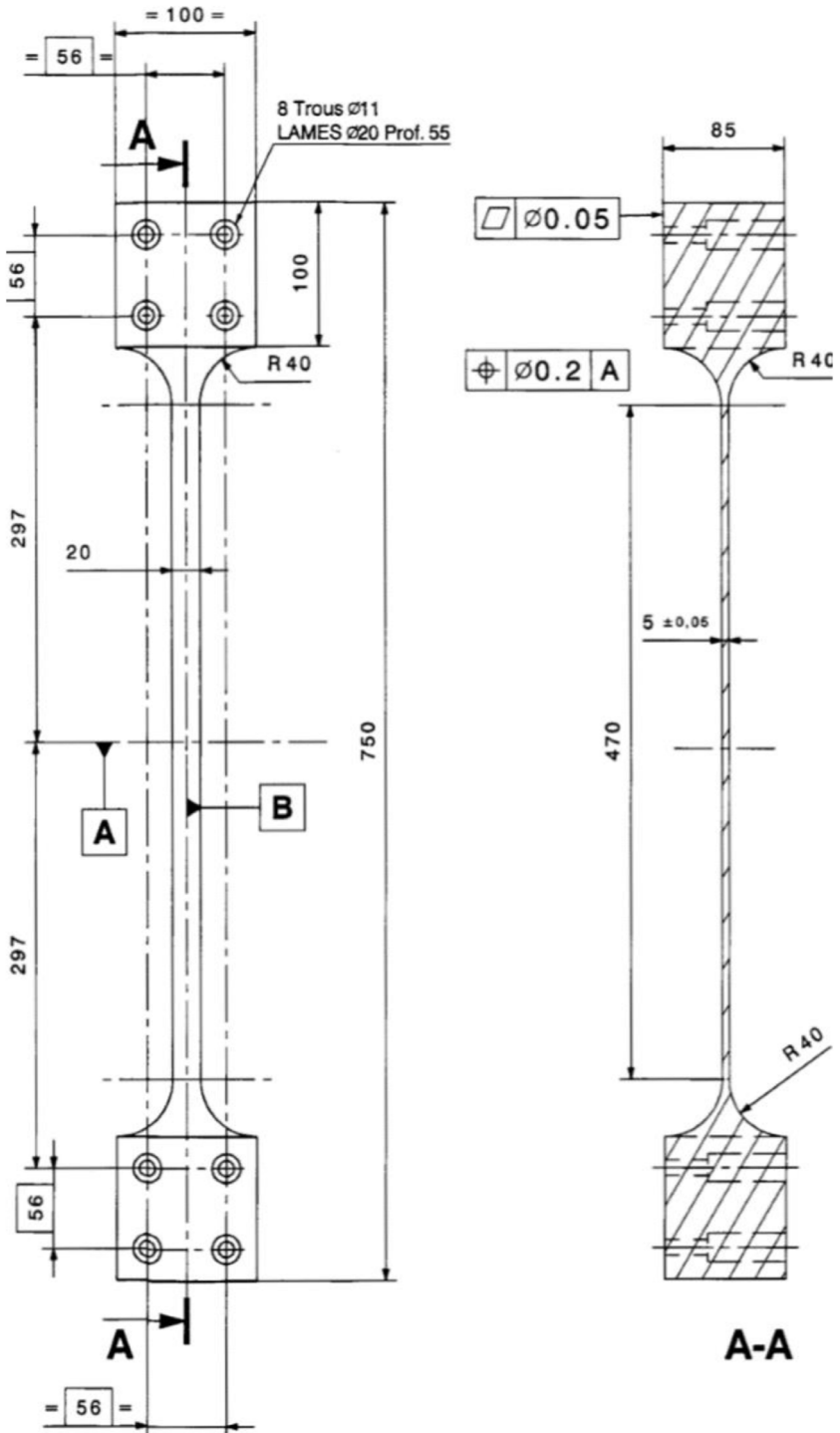


Fig. 2. Technical drawing of the benchmark CEA-beam.

0.10 m and $x = +0.10$ m) using Multi-Input-Multi-Output (MIMO) random control technology. The shakers configuration is designed to excite the modes of the beam within a chosen bandwidth of frequencies. It should be noted that the position of each shaker is fixed for all the experiments and symmetrical about the center of the beam. This choice will make it possible to highlight the contributions of symmetrical or anti-symmetrical modes of the beam depending on the given correlation between the two broadband random excitations. For a chosen bandwidth of frequencies, four types of correlation between the two excitations will be tested: in phase, opposite phase, quadrature phase and uncorrelated.

All the dataset are provided in [5]. Experimental results are decomposed into two main parts:

- First of all (experiment 1 corresponding to the files named '*Experiment1*'), the global vibrational behavior of the beam system is investigated. More specifically the effects of the four configurations of the two chosen broadband random excitations (i.e., correlated excitations in phase, opposite phase and quadrature phase, and uncorrelated excitations) are observed. All experiments are performed with a level of excitation (≈ 0.71 N RMS) along the bandwidth [20–1000 Hz].
- Secondly (experiment 2 corresponding to the files named '*Experiment2*'), more particular attention is devoted to the non-linear signature of the system and the evolution of the non-linear contributions and harmonic components according to the different configurations of broadband random excitations (i.e., correlated excitations in phase, opposite phase and quadrature phase, and uncorrelated excitations). In order to reach such an objective, all experiments are conducted for one level of excitation (≈ 0.5 N RMS) along the bandwidth [20–500 Hz] and for one level of excitation (≈ 0.0035 N RMS) along the bandwidth [500 – 1000 Hz].

Results provided in [1] display the experimental results from the dataset for experiment 1 and experiment 2, respectively. All results from this post-processed records are also analyzed and discussed in [1] for characterization of the nonlinear bending behavior of a beam subjected to two broadband correlated or uncorrelated random excitations.

Ethics Statements

Not applicable (this work does not involve human subjects, animal experiments or data collected from social media platforms).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

[Dataset of measurements for the CEA-beam system subjected to two correlated or uncorrelated broadband random excitations \(Original data\)](#) (Mendeley Data).

CRedit Author Statement

S. Talik: Methodology, Validation, Investigation, Writing – original draft, Writing – review & editing, Visualization; **M. Claeys:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition; **J.P. Lambelin:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing –

review & editing, Supervision, Project administration, Funding acquisition; **A. Banvillet**: Methodology, Validation, Investigation, Resources, Writing – review & editing; **J.J. Sinou**: Conceptualization, Methodology, Validation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration.

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