

Data Sheet of openBridgeLAB Measurements

Large-scale experiment on a bridge structure for damage study using vibration-based output-only SHM

File Management

The conducted experiments result in one dataset. Due to the nature of the setup, the data is recorded while being influenced by varying excitation and conditions. Several campaigns were conducted in which damaged states were measured.

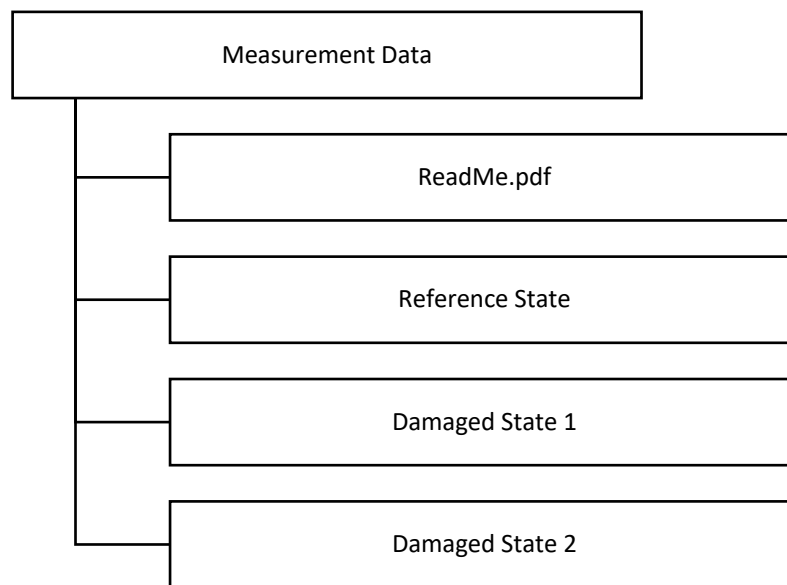


Figure 1: File Organization Structure.

All data is saved in hierarchical data format (HDF5) and sorted chronologically in a folder structure. The File is named by 'YYYY-MM-DD_Messung_Bautzen_hhmm.h5' for all measurements.

Catalog

A catalog over the dataset is accompanying each dataset. They are designed to help the user orient in the large datasets. They provide a number of information of the measurements and about occurring EOC. An overview over the information provided, a translation of the information and further information about them is provided in Table 1.

Table 1: Overview of information provided in catalogs.

Field	Definition
Date	Time and date of measurement
Name	Filename
Project	Title of project or ensemble
Duration	Duration of measurement in seconds
Ry0_Ch3	Average process power of channel 3
Ry0_Ch11	Average process power of channel 11
Ry0_Ch19	Average process power of channel 19
Ry0_Ch27	Average process power of channel 27
Quantification Range ($\pm V$)	Used Quantification range for this measurement
Indoor Temperature ($^{\circ}C$)**	Air temperature under the bridge (field 1)
Indoor Humidity (%)**	Relative air humidity under the bridge (field 1)
Outdoor Temperature ($^{\circ}C$)	Air temperature on top of the bridge
Outdoor Humidity (%)	Relative air humidity on top of the bridge
Dew Point ($^{\circ}C$)	Air dew point
Wind (m/s)	Mean velocity of wind
Wind variance (m/s)	Variance of wind velocity
Gust (m/s)	Mean velocity of wind gusts
Wind Direction ($^{\circ}$)	Average wind direction*
Std. of Wind Direction ($^{\circ}$)	Standard deviation of wind direction
ABS Pressure (hpa)**	Absolute air pressure
Solar Rad. (W/m^2)	Solar radiation
Hourly Rain (mm)**	Amount of hourly rain fall
Event Rain (mm)**	Amount of event rain fall

* magnetic north is at 330° and along the bridge axis

** data was not recorded for Damaged State 2 due to technical problems.

Structure of Data

Each file contains the Group '/', with the dataset 'RecBuff'. This contains the Attributes of the measurement and the data, consisting of timestamp and the acceleration measurement data.

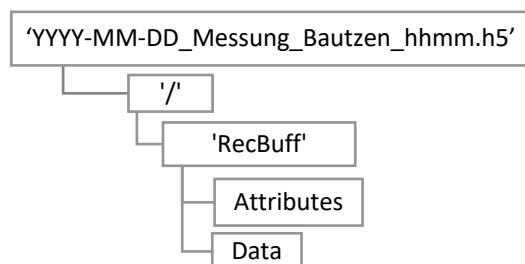


Figure 2: Data organization in file structure.

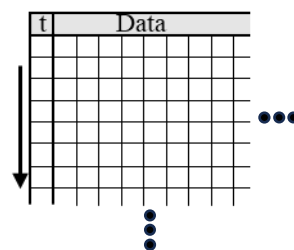


Figure 3: Organization of Dataset.

Attributes

The attributes are automatically written based on the settings of a measurement campaign. They are originally created in german language, a translation and definition are shown in Table 3.

Table 3: Table of attributes, their translation and definition.

Attribute	Translation	Definition
Ersteller	Creator	Person overseeing the measurement
Projektname	Project Name	Name of Project or ensemble
Ort	Location	Location
Kommentar	Comments	Additional comments
Datum	Date	Time and date of creation
Anregung	Excitation	Main Excitation occurring
Messdauer	Time of Measurement	Duration of one measurement
Einschwingzeit	Settling time	Duration between first parametrization of measurement system and start of recording for the first measurement of a group
Anzahl Kanäle	Number of Channels	Number of acceleration measurement channels
Sampletime	Sampletime	Number of samples per second (sample frequency)
Decimierungsfaktor	Decimation factor	Factor by which downsampling was applied afterwards

Data

Timestamp

The timestamp is stored in the first column of the data (see Figure 3) and in microseconds [μs]. The sample frequency of the measurements is 1 kHz (one sample was recorded for every 100 μs).

Data

The presented acceleration data is in [m/s^2], all quantification factors and sensitivities are already factored in. The channels are sorted by columns, the first channel (Ch1) is in the second column (after the timestamp) and the last channel (Ch32) is stored in column 33 (see Figure 3). The used EtherCAT Terminal (ELM3602 by Beckhoff) are equipped with an inbuilt low-pass filter, to prevent aliasing, and a parameterizable FIR high-pass filter, to filter the influences of IEPE Bias Currents (AcCoupling). The combined transfer function is shown in Figure 4.

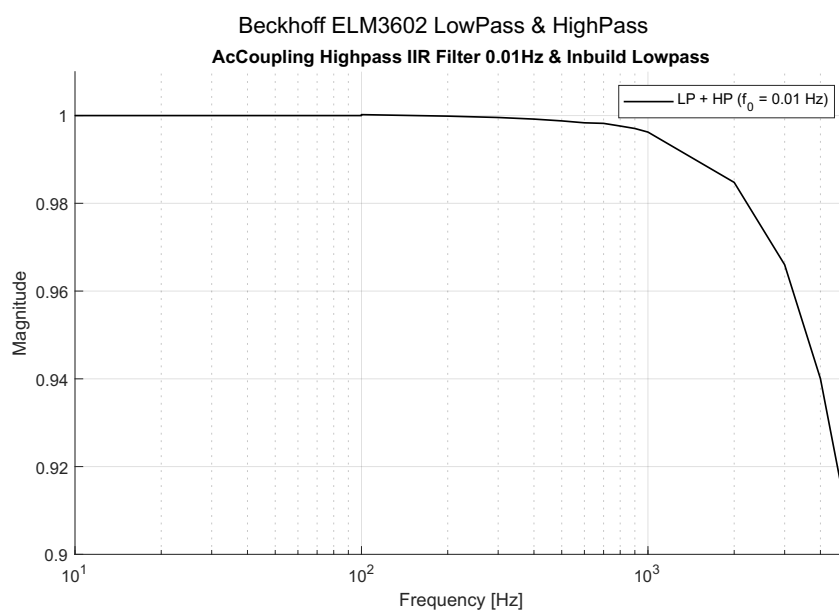


Figure 4: Transfer function of the ELM3602 terminal.

Downsampling

The initial sample rate of 10 000 Hz resulted in a large dataset. To decrease the size of the dataset, the number of samples was reduced. To downsample the time series data from 10 kHz to 1 kHz, a lowpass FIR filter with zero-phase filtering was designed. The filter employs a Kaiser window with a passband frequency of 500 Hz. The stopband attenuation is set at 55 dB, preventing aliasing (see Figure 5).

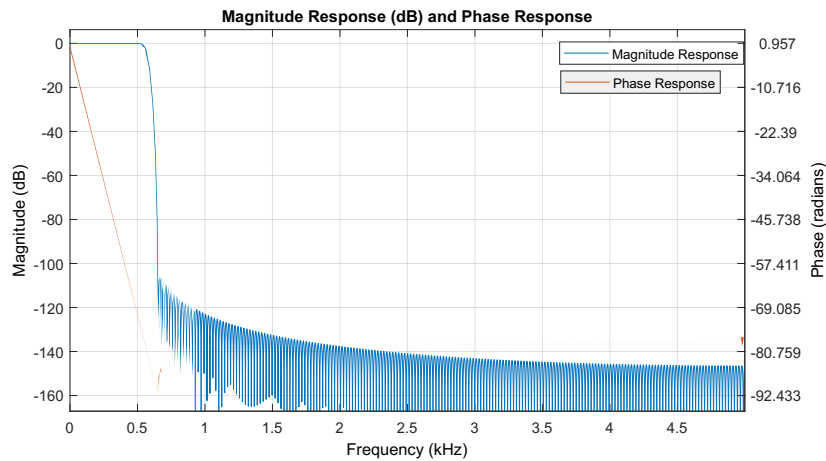


Figure 5: FIR-Filter used for anti-aliasing downsampling.

Datasets with the original sample rate of 10 000 Hz can be provided individually upon request!

The sensor position does not correspond directly to the channel number. When working with the data, a mapping between sensor positions and channel numbers is required to determine which sensor corresponds to each entry in the dataset. This mapping is provided in Table 5.

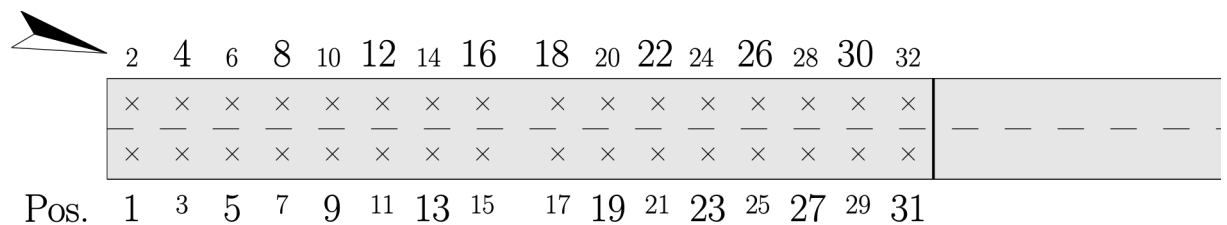
Position	Ch.-Nr.	South	Position	Ch.-Nr.
1	1	Field 1	2	9
3	2		4	10
5	3		6	11
7	4		8	12*
9	5		10	13
11	6		12	14
13	7		14	15
15	8		16	16
17	25	Field 2	18	17
19	26		20	18
21	27		22	19
23	28		24	20
25	29		26	21
27	30		28	22
29	31		30	23
31	32		32	24
		Field 3		
		North		

Data Sheet: 28 August 2026

Dataset: **openBridgeLAB** **Setup**
(45 m)



Sensor Positions



Location:	51°19'98.45"N, 14°40'84.94"E		
Excitation:	Ambient		
Acceleration Sensors:	PCB393A03		
Number of Measurements:	284	Size of Dataset:	43 GB
Time period:	29.04.-30.04.2025 12.05.-13.05.2025 29.09.-30.09.2025	Duration Measurement	per 600 s
Sample Frequency:	1 kHz	Channels:	32
Ensembles:	1 Reference & 2 Damaged States		
Day	No. of Meas.	Time [24h]	Event
29.04.-30.04.2025 <i>Reference State</i>	56	18:00 20:15	Set up measurement system Start measurements Reference State
12.05.-13.05.2025 <i>Damaged State 1</i>	103	10:00 12:15	Set up measurement system Start measurements Damaged State1
29.09.-30.09.2025 <i>Damaged State 2</i>	125	10:00 12:15	Set up measurement system Start measurements Damaged State 2