

## 1. Introduction

This document describes a laboratory-scale dataset acquired on a five-level steel frame instrumented with **two sensor types** (accelerometers and resistive foil strain gauges) and **two sensor layouts** per sensor type (optimized by Efl algorithm and suboptimal). The dataset is intended for research and benchmarking in operational modal analysis (OMA), optimal sensor placement (OSP), and strain-based modal identification.

The test structure is a steel frame comprising five levels, as depicted in Figure 1. Each level consists of a 500 × 250 mm slab supported by two beams. The beams are built from T-profiles (base and height of 30 mm, thickness 4 mm), and the columns have a 30 × 2 mm rectangular cross-section. Beam-to-column joints are assembled using small angle brackets fastened with screws.



*Figure 1. Steel frame before (left) and after (right) the instrumentation.*

## 2. Instrumentation

The structure was instrumented with:

- Triaxial MEMS accelerometer modules (GY-61 incorporating ADXL335)
- Resistive foil strain gauges (FLAB-6-11, 120 Ω nominal resistance). Strain was measured via Wheatstone bridge (quarter-bridge) and digitized through HX711 modules (gain 128, 24-bit ADC).

Acquisition was performed with an Arduino MEGA microcontroller.

## 3. Signals

Processed time series for the four cases (optimal and suboptimal layouts for accelerometers and strain gauges) are provided in the repository (see “time\_series/”), its properties summarized in Table 1.

Table 1. Signals properties

|                         | Accelerometers        | Strain gauges         |
|-------------------------|-----------------------|-----------------------|
| Units                   | m/s <sup>2</sup>      | $\epsilon$            |
| Sampling frequency [Hz] | 207.19                | 70.57                 |
| Record length [s]       | 1000                  | 708                   |
| Spike removal           | No                    | Yes                   |
| Detrending              | Yes                   | Yes                   |
| Band-pass filter        | 5th order Butterworth | 5th order Butterworth |
| Band-pass cutoffs       | 0.25-36 Hz            | 0.25-36 Hz            |

Time series are provided as semicolon-separated plain-text files with a header row (e.g., t;channel\_1;...;channel\_8). The channel columns are ordered consistently with the “CHANNELS (SAP2000 MODEL)” section in the corresponding modal results file, which provides the SAP2000 DOF/element reference for each channel.

#### 4. Sensor layouts

A general overview of the channel locations is provided in the **channels\_locations.pdf** document. The exact SAP2000 location associated with each channel is reported in the file containing the identified modal properties (under the **CHANNELS** section), where each channel is defined by its SAP2000 DOF/element reference. The notation adopted is as follows:

- **Accelerometers (joint displacement DOFs):** <JointObject>\_<Direction> where <Direction> is one of  $\pm U1$ ,  $\pm U2$ ,  $\pm U3$ , according to the SAP2000 local axis convention shown in Figure 2. For example, 27\_-U1 denotes a channel located on **Joint Object 27, measuring on the negative U1 local axis**.
- **Strain gauges (frame element faces):** <FrameObject>.<FrameElement>\_<Position> where <Position> is one of up, right, bottom, left, defined with respect to the local axes of the corresponding SAP2000 frame element (Figure 2). For example, 263.1\_up denotes a strain gauge located on **Frame Object 263, mesh element 1, on the upper face** in the local coordinate system.

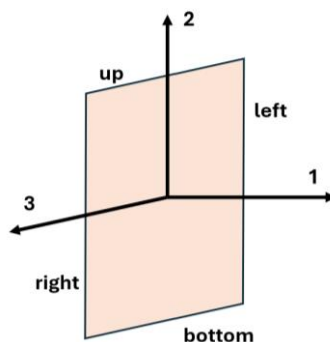


Figure 2. Local axes in SAP2000 and frame element faces.

## 5. Modal identification

The modal identification has been performed with MOVA software. COV-SSI algorithm has been used, with the following hyperparameters:

*Table 2. COV-SSI algorithm*

|                       | Accelerometers          | Strain gauges           |
|-----------------------|-------------------------|-------------------------|
| Time lag [s]          | 2.688                   | 2.678                   |
| Model order           | 2-80                    | 2-80                    |
| Clustering            | Hierarchical clustering | Hierarchical clustering |
| Min. Cluster size     | 8                       | 10                      |
| Max. Cluster distance | 0.03                    | 0.06                    |