

Home work 3 (HW03):

Due date is: Thursday, Dec. 07, 2023

P1: The structural characteristics of a 5-DOFs shear building is illustrated in Fig. 1.

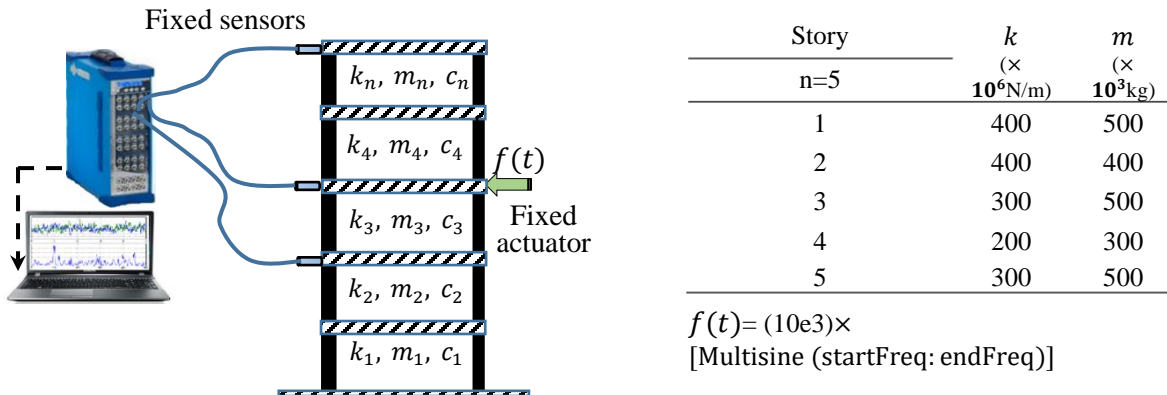


Fig. 1. 5- DOF shear building considered for the first problem; external force $f(t)$ is in N and applied at $n=3$ for a total duration of 5 sec (output signals are contaminated by 5% signal-to-noise-ratio (SNR)).

As its illustrated in this figure, there are only three sensors (accelerometers) embedded at DOFs: 2, 3 and 5 to measure the acceleration responses. Special care must be taken for the choice of selecting an appropriate sampling rate per second (S/s). The structure is initially at rest condition and the damping ratio of 5% is applied for the first two modes. Firstly, simulate the structural responses using the abovementioned dynamic characteristics and assume the simulated responses as the measured output signals (HW00+) and then;

Given tasks:

- 1- Identify 7 unknown variables corresponding to the structural stiffness (a known mass scenario), alfa and beta (Rayleigh damping coefficients) in time-domain using your own codified genetic algorithm (GA) or GA function in MATLAB.
- 2- Identify 7 unknown variables corresponding to structural stiffness (a known mass scenario), alfa and beta (Rayleigh damping coefficients) in frequency-domain (frequency data e.g., natural frequencies, pure mode shapes or FRF data) using your own codified genetic algorithm (GA) or GA function in MATLAB.
- 3- Identify 12 unknown variables corresponding to structural stiffness, mass (an unknown mass scenario), alfa and beta (Rayleigh damping coefficients) in time-domain using your own genetic algorithm (GA) or GA function in MATLAB.

- 4- Identify **12** unknown variables corresponding to structural stiffness, mass (an unknown mass scenario), alfa and beta (Rayleigh damping coefficients) in time-domain using particle swarm optimization (PSO) strategy.
- 5- Make a logical comparison between results obtained for tasks 3 and 4.
- 6- Consider two sub-structures (SS), i.e., DOFs: [4,5] and [1,2,3] as the first and second SSs, respectively (thus, DOF 3 is supposed to be an interface DOF). Identify **12** unknown variables corresponding to structural stiffness, mass (an unknown mass scenario), alfa and beta (Rayleigh damping coefficients) in time-domain using particle swarm optimization (PSO) strategy through a sub-structural approach (note that an output only identification problem is considered).
- 7- Consider a full measurement scenario, and a known mass problem, also taking into account the externally applied loading as shown in Fig. 1 (applied on 3rd story), then implement PSO through a time-domain approach to identify the time history of input loading (externally applied loading) as well as the unknown stiffness parameters k_1 to k_5 .