RIYA Week 8 Presentation

Comparison of Experimental Results with Simulation Results - Part 2

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Tasks Accomplished

- Attempted to **tune** the damping and spring parameters in order to bring simulation results closer to experimental results

- Comparison of **experimental and simulation results** obtained for the **dynamics** of the two-spring stack system

Parameter Tuning Process

- **Grid search** over different values of damping coefficient (c) and spring parameters to observe broad patterns.

- Effect of increasing c

    - **Motion transmissibility** in the **low-frequency** range **increases**

    - **Motion transmissibility** in the **high frequency** range **reduces**

    - **Resonance frequency** decreases

- For the spring and damping parameters used previously, the damping coefficient was not sufficient, however on increasing c, the **resonance frequency** went below **4 Hz**

- **Hypothesis -** Will increasing the stiffness of the spring stack help ?

Parameter Tuning Process

- Increased the Young's modulus by **5%** so that the force-deflection curve has major overlap with the forward curve. **Will it work ?**

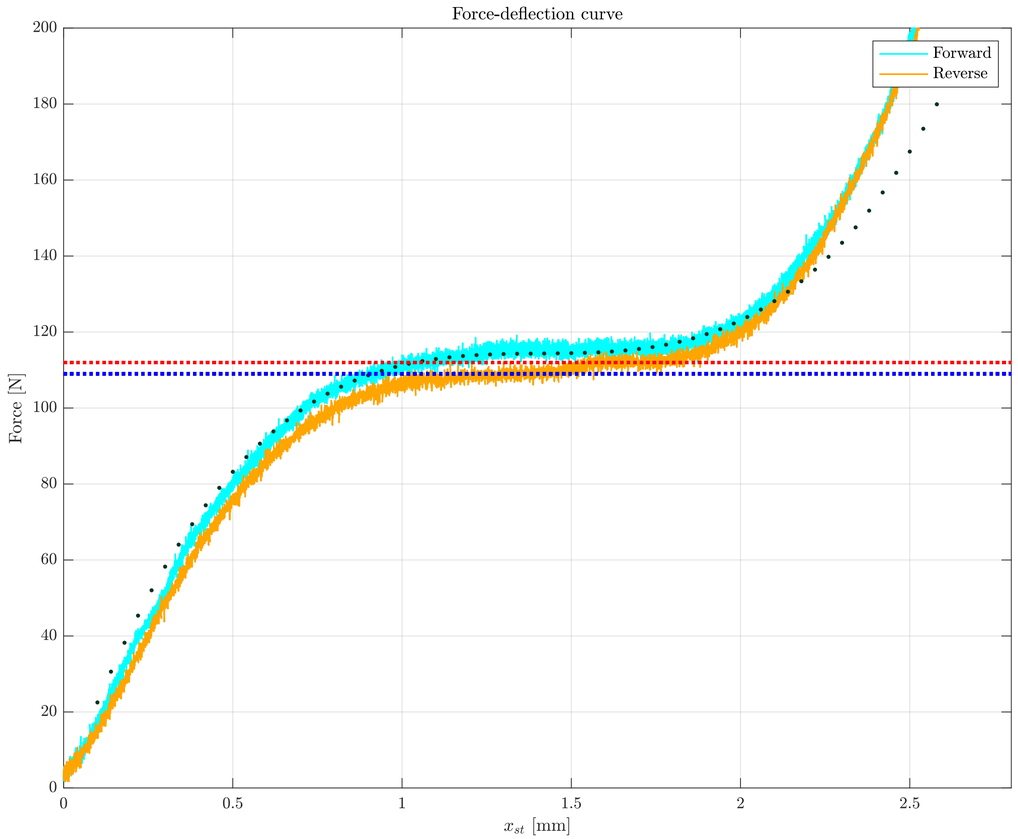

Figure - Force deflection curve for $h_1/\tau = h_2/\tau = 1.41$, $E = 210$ GPa

Simulation Process

PARAMETERS AFTER CRUDE TUNING -

- $h_1/\tau = h_2/\tau = 1.41$
- $E = 210$ GPa
- $m = 11.2$ kg
- $c = 0.4$ Ns/mm (Increased by a **factor of ~10** from before)
- $x_{base}(t) = 0.25\sin(2\pi ft)$ (in mm)

f is the frequency of the base excitation, which is varied from **4 Hz to 26 Hz** at intervals of **2 Hz**

Case 1 - $f = 4$ Hz

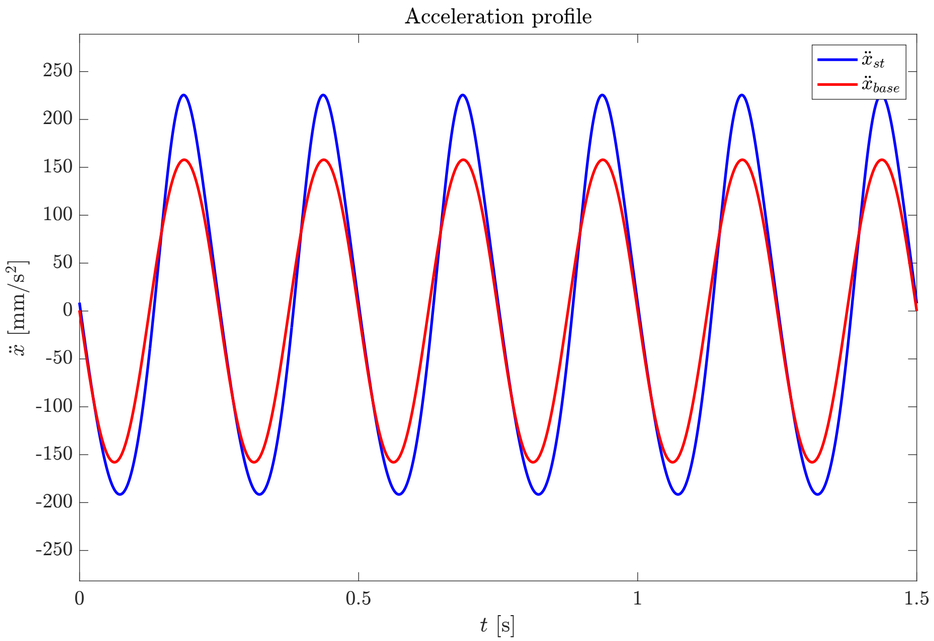

Figure - Simulation result for $f = 4$ Hz

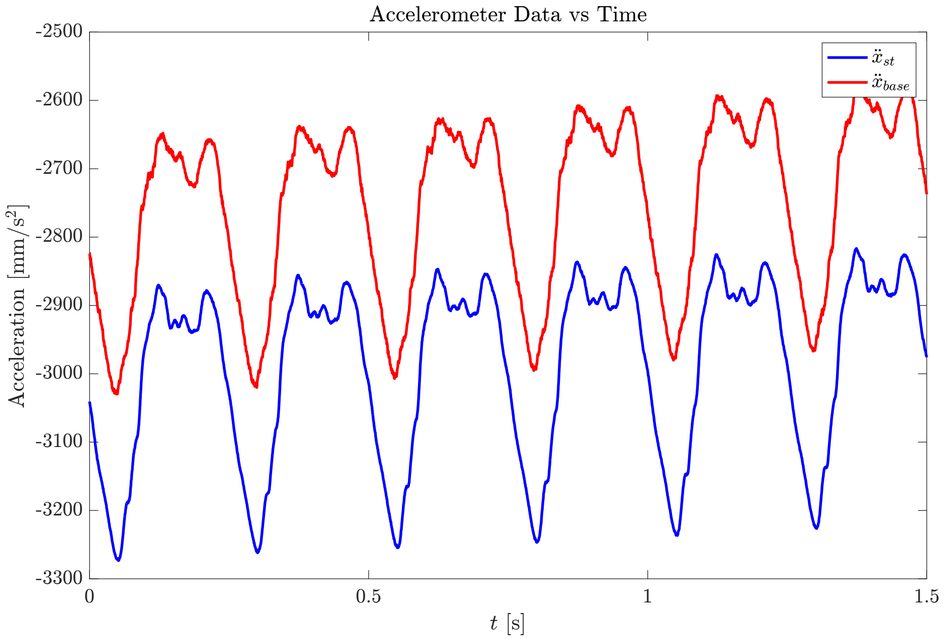

Figure - Experiment result for $f = 4$ Hz

Case 2 - $f = 6$ Hz

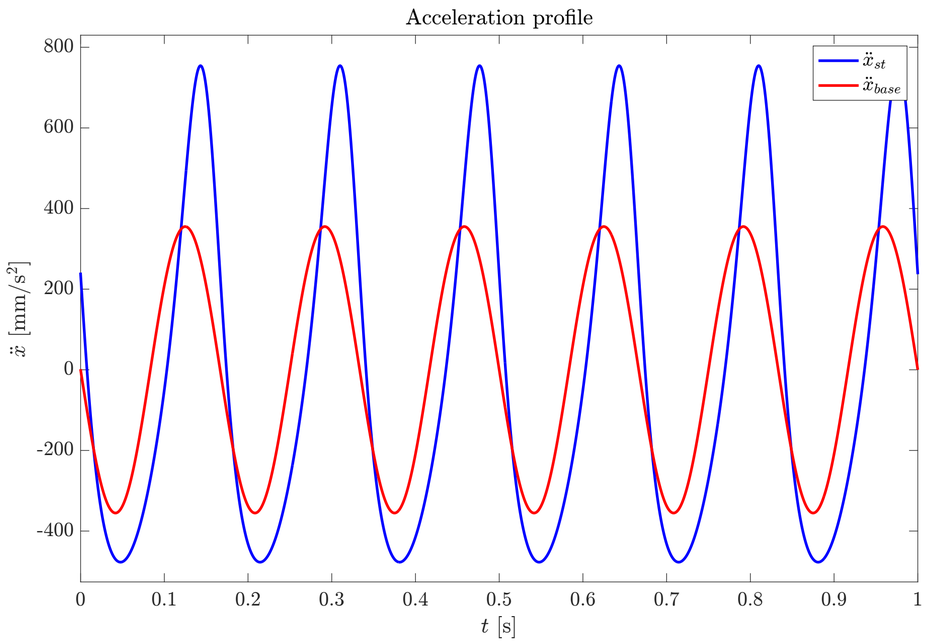

Figure - Simulation result for $f = 6$ Hz

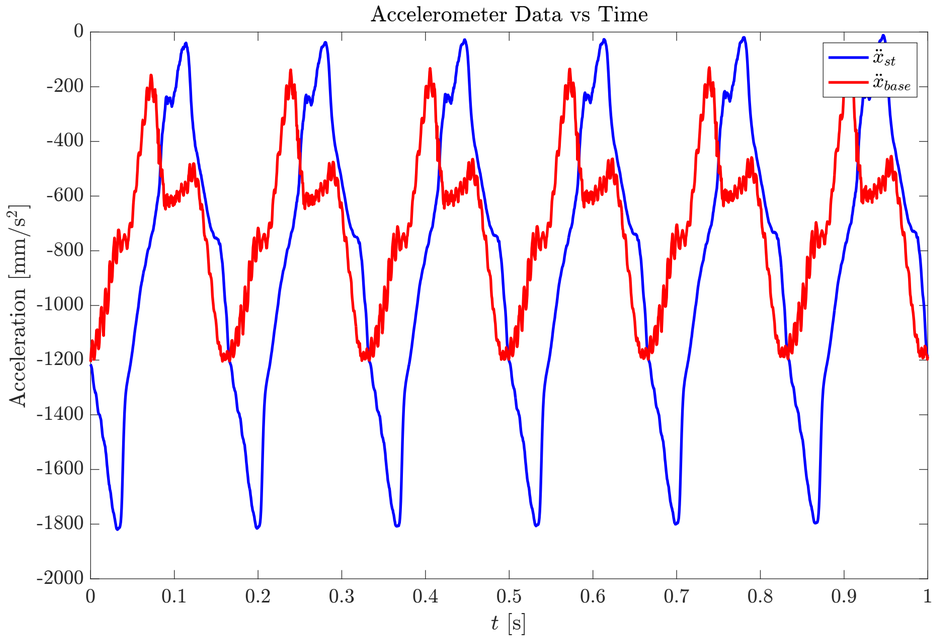

Figure - Experiment result for $f = 6$ Hz

Case 3 - $f = 8$ Hz

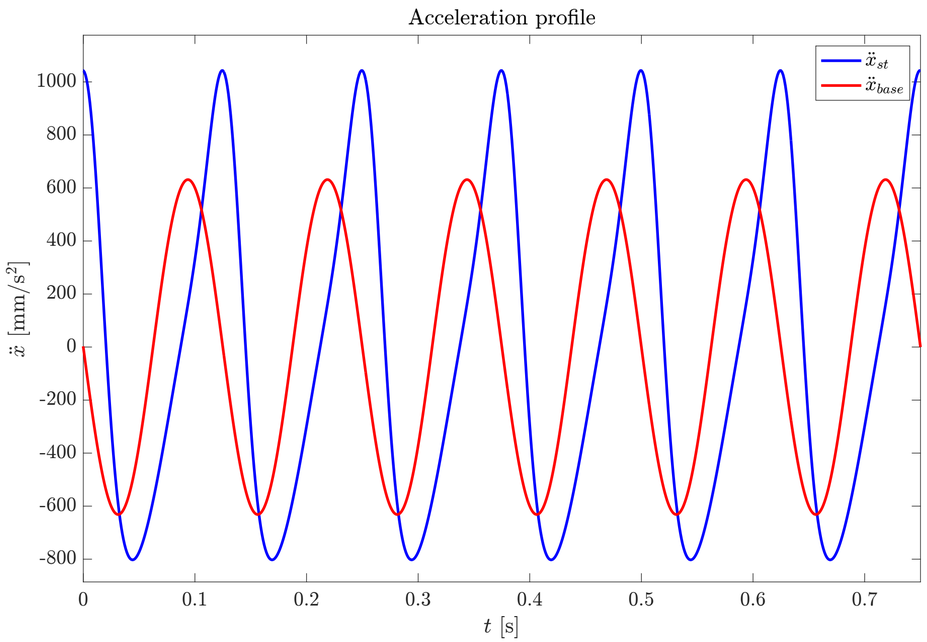

Figure - Simulation result for $f = 8$ Hz

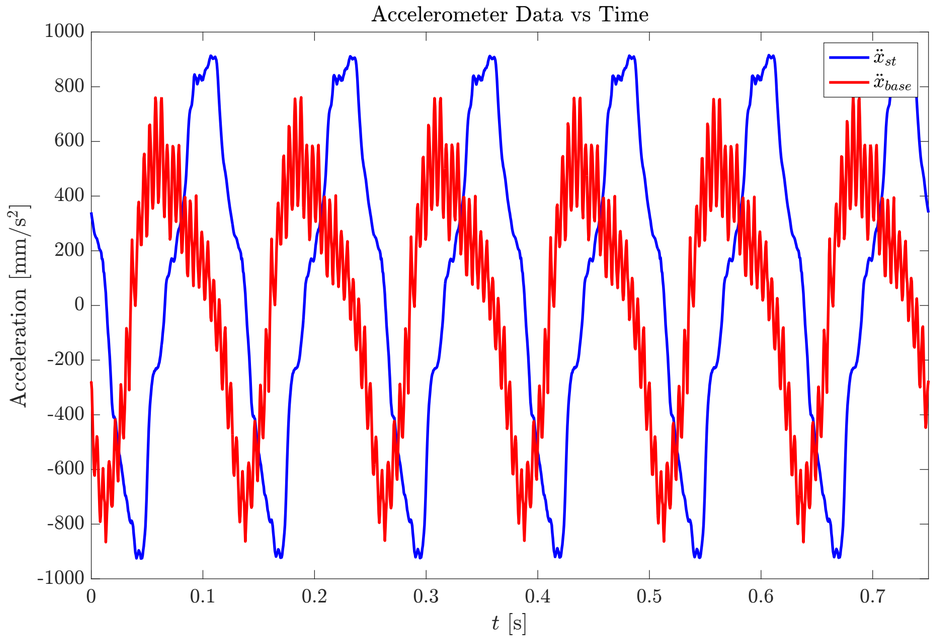

Figure - Experiment result for $f = 8$ Hz

Case 4 - $f = 10$ Hz

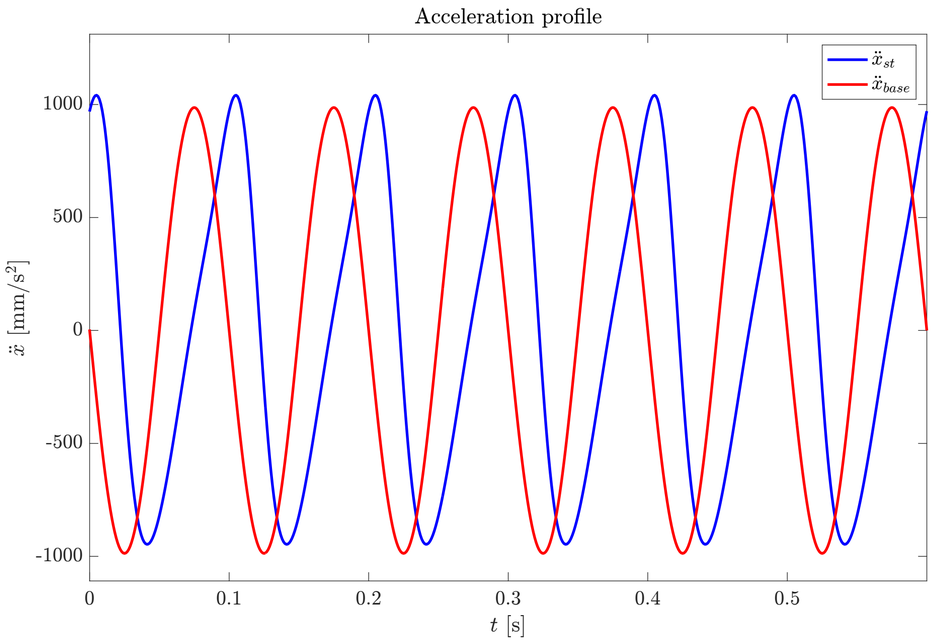

Figure - Simulation result for $f = 10$ Hz

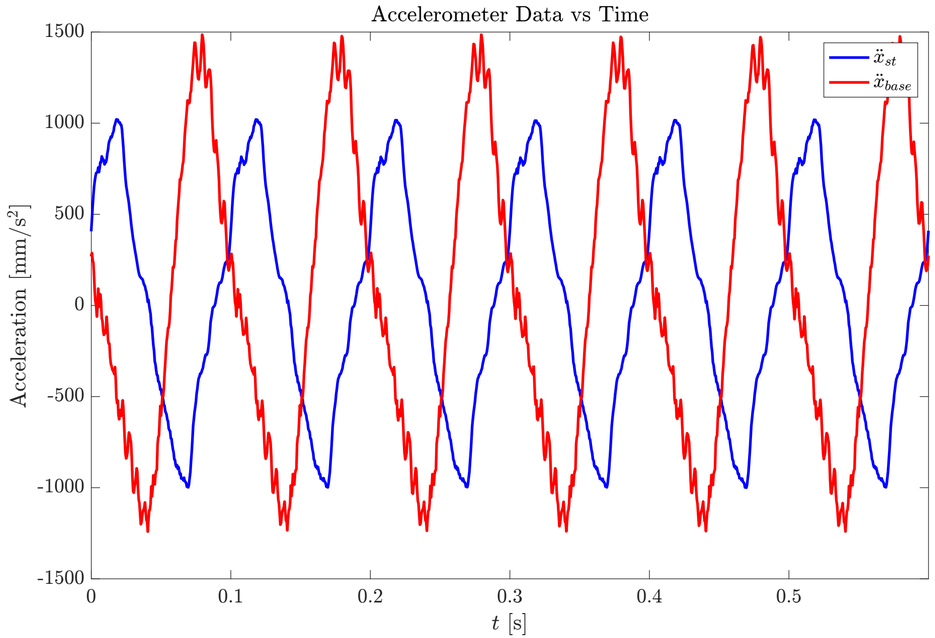

Figure - Experiment result for $f = 10$ Hz

Case 5 - $f = 12$ Hz

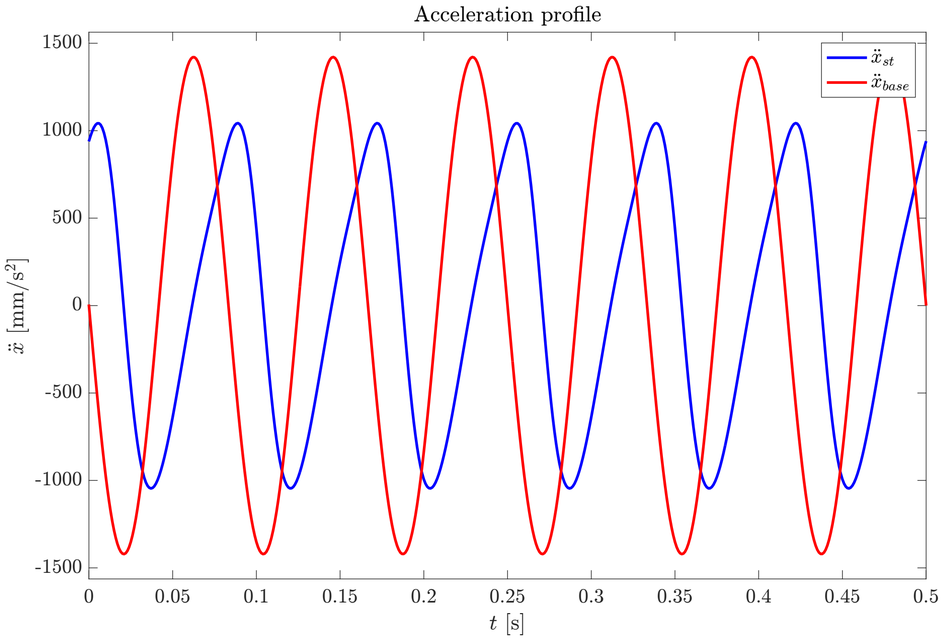

Figure - Simulation result for $f = 12$ Hz

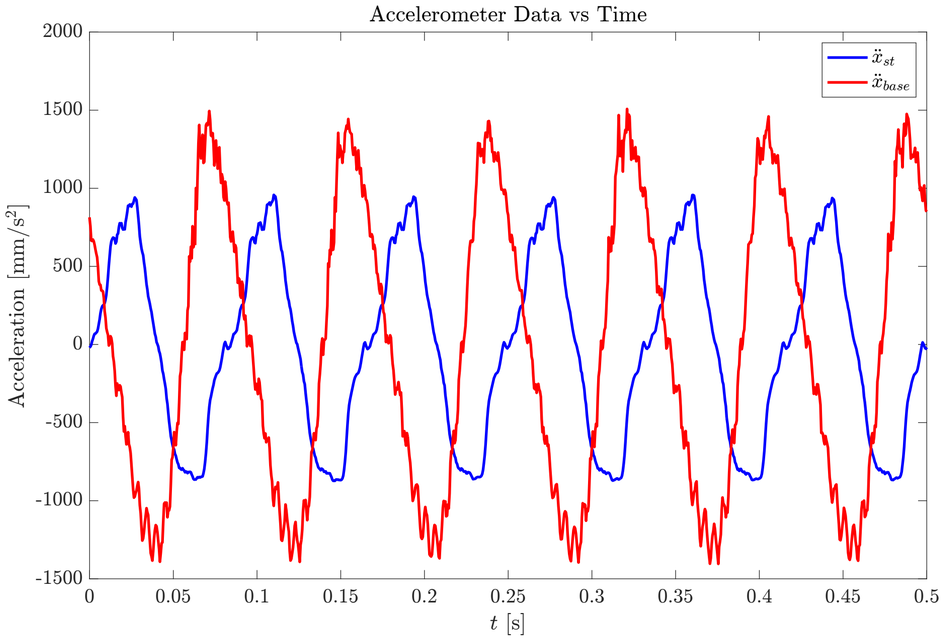

Figure - Experiment result for $f = 12$ Hz

Case 6 - $f = 14$ Hz

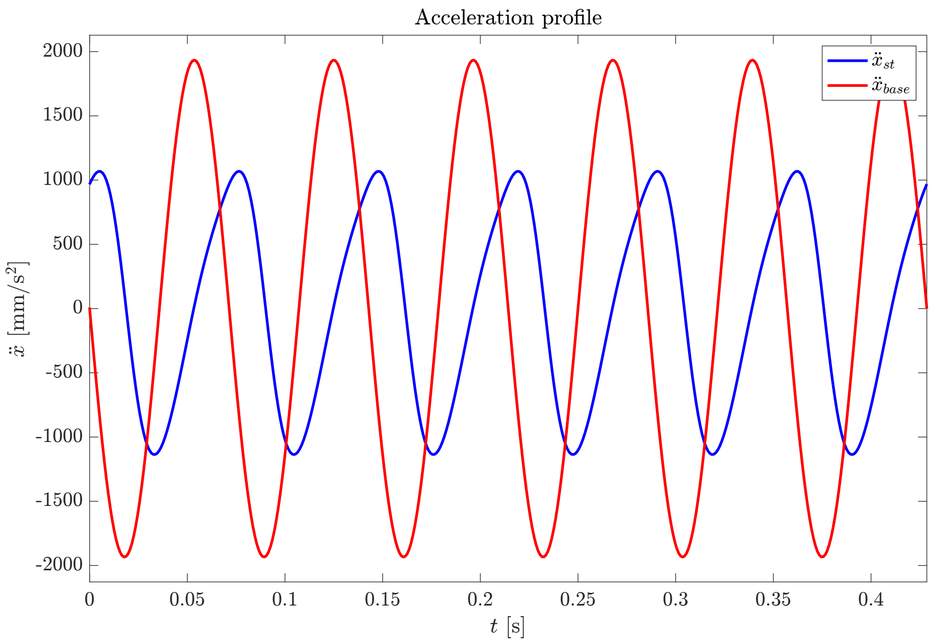

Figure - Simulation result for $f = 14$ Hz

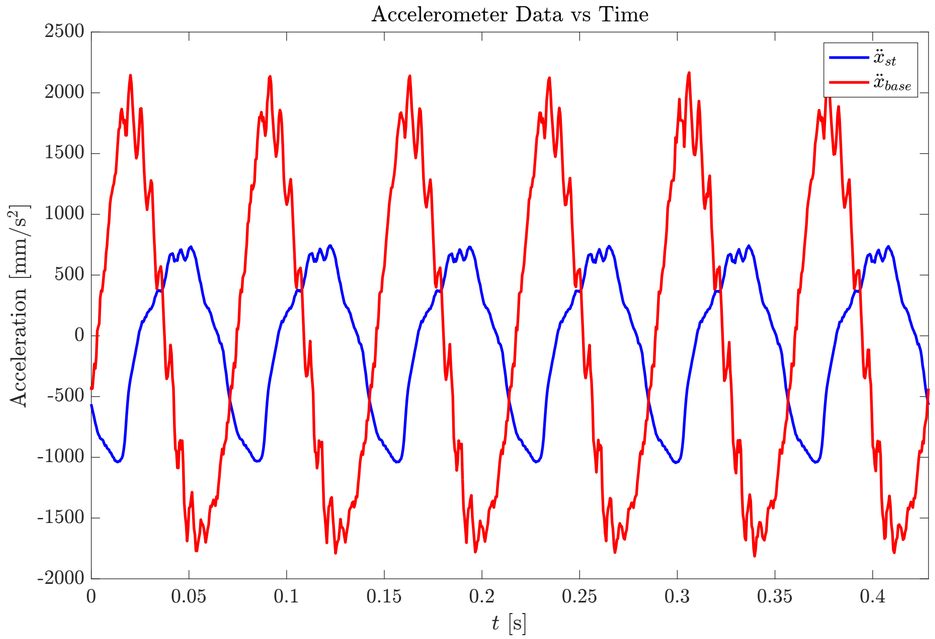

Figure - Experiment result for $f = 14$ Hz

Case 7 - $f = 16$ Hz

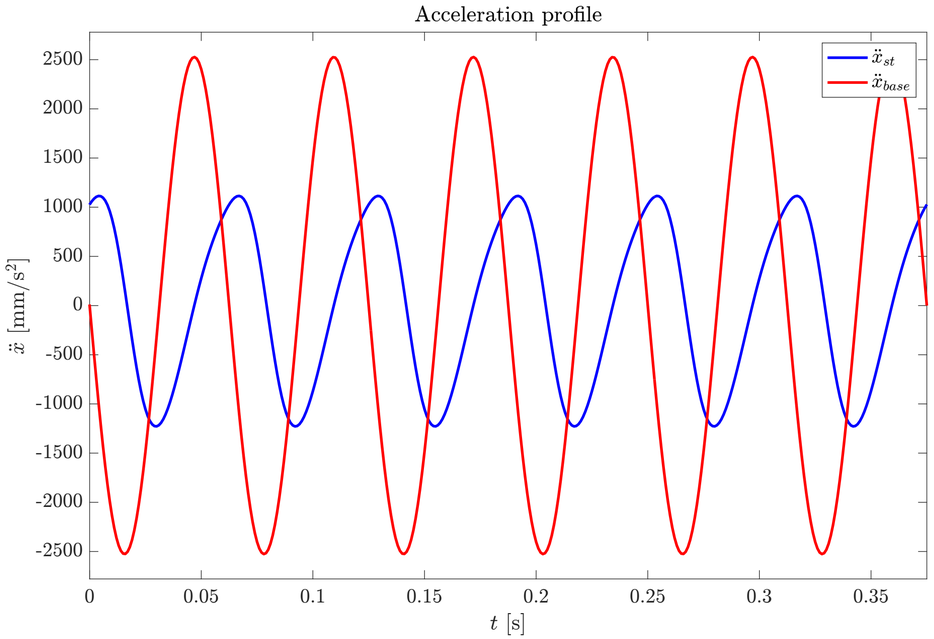

Figure - Simulation result for $f = 16$ Hz

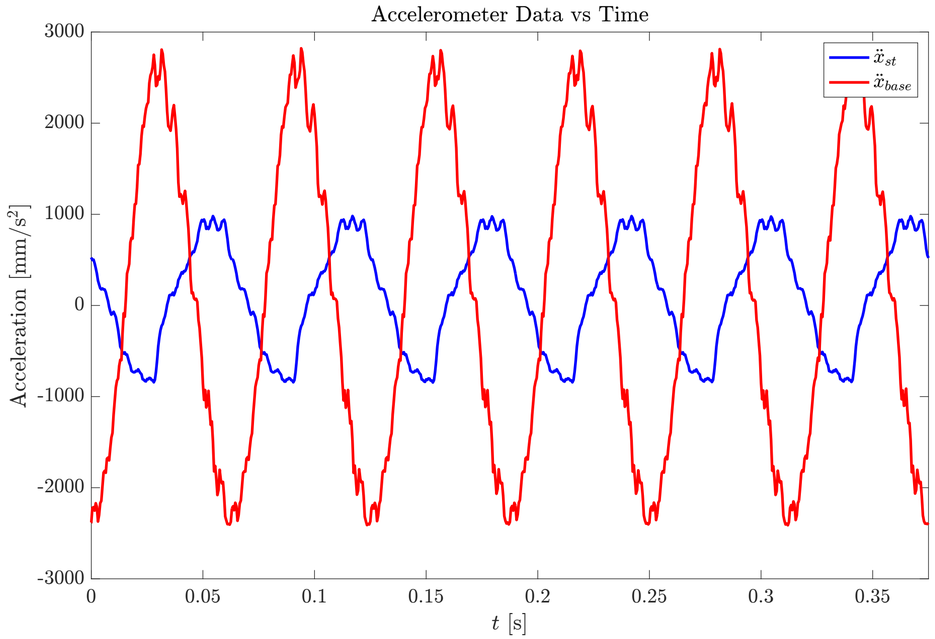

Figure - Experiment result for $f = 16$ Hz

Case 8 - $f = 18$ Hz

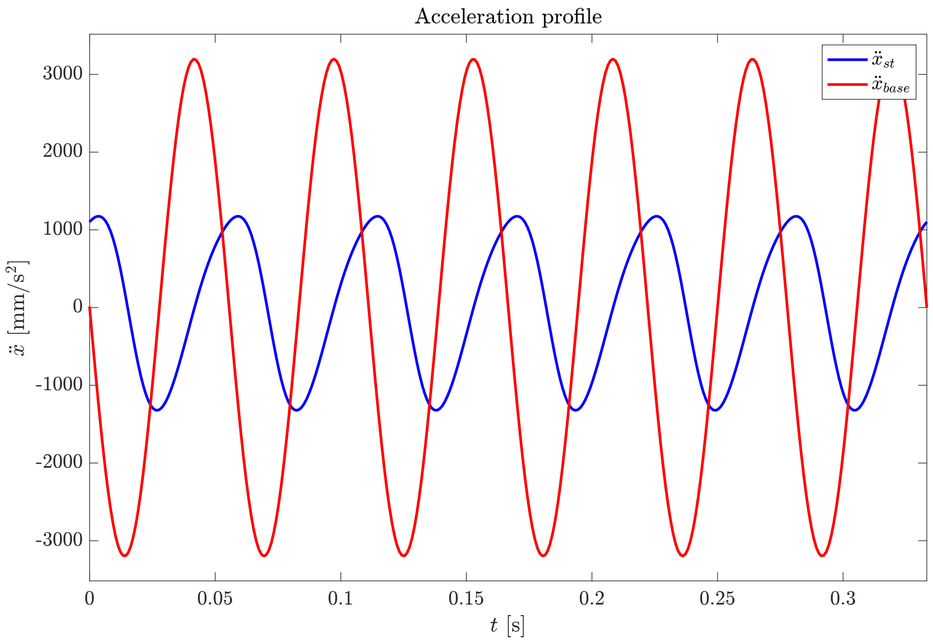

Figure - Simulation result for $f = 18$ Hz

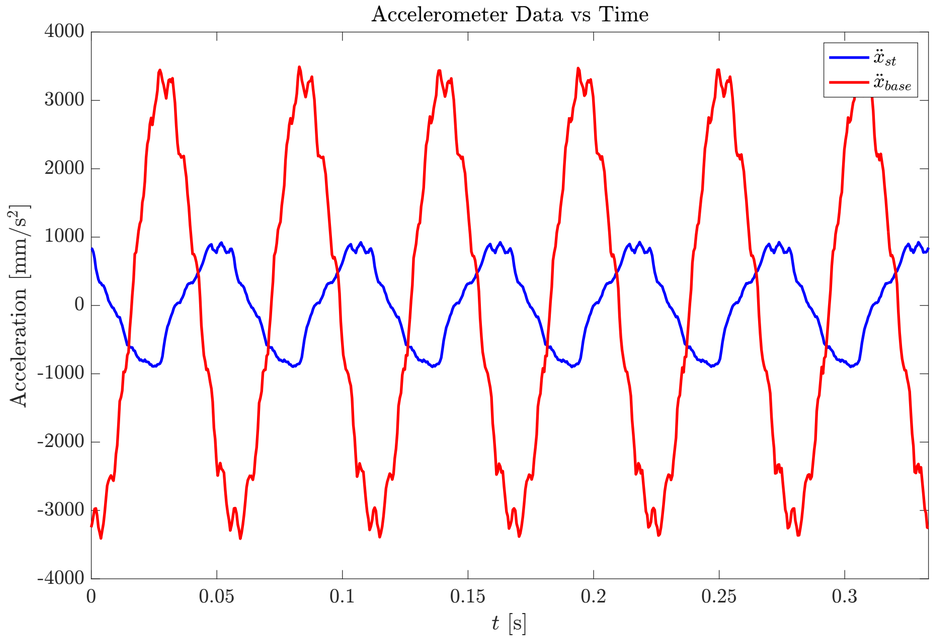

Figure - Experiment result for $f = 18$ Hz

Case 9 - $f = 20$ Hz

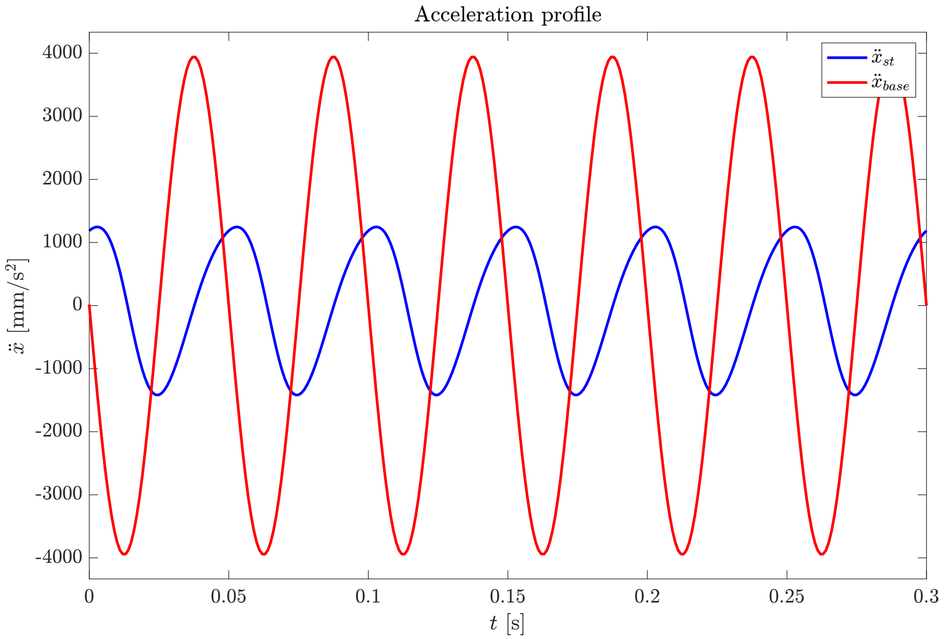

Figure - Simulation result for $f = 20$ Hz

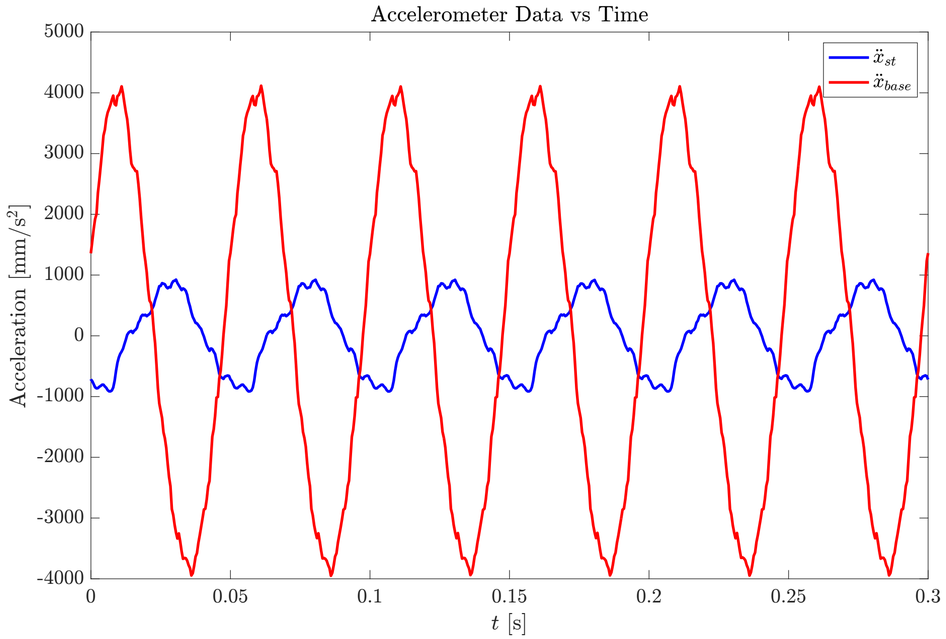

Figure - Experiment result for $f = 20$ Hz

Case 10 - $f = 22$ Hz

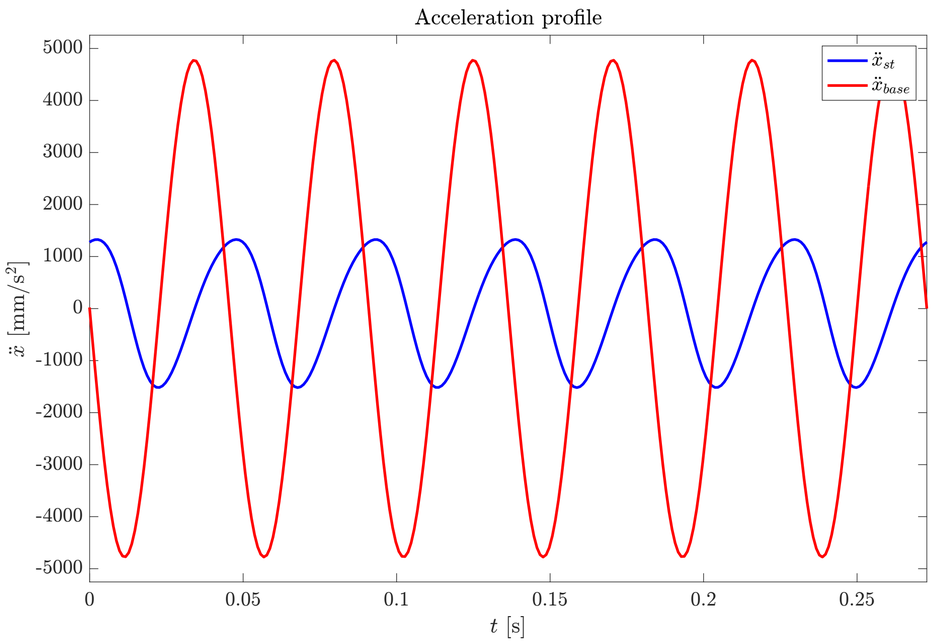

Figure - Simulation result for $f = 22$ Hz

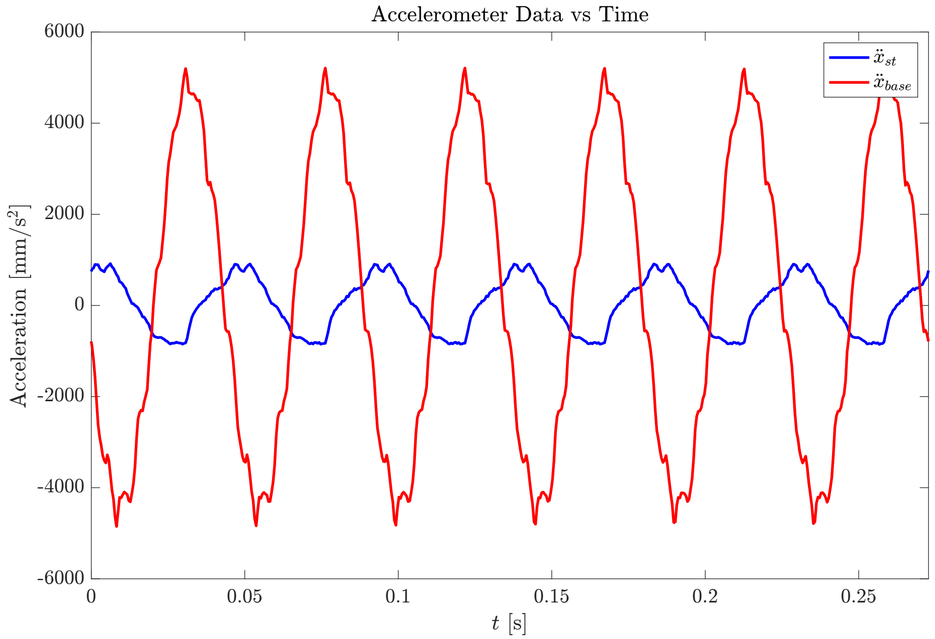

Figure - Experiment result for $f = 22$ Hz

Case 11 - $f = 24$ Hz

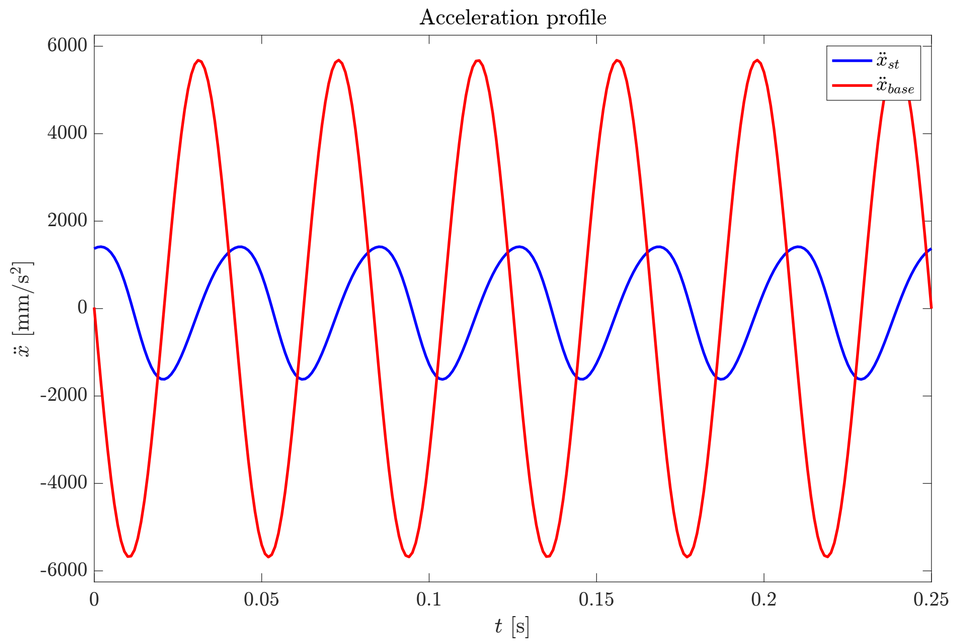

Figure - Simulation result for $f = 24$ Hz

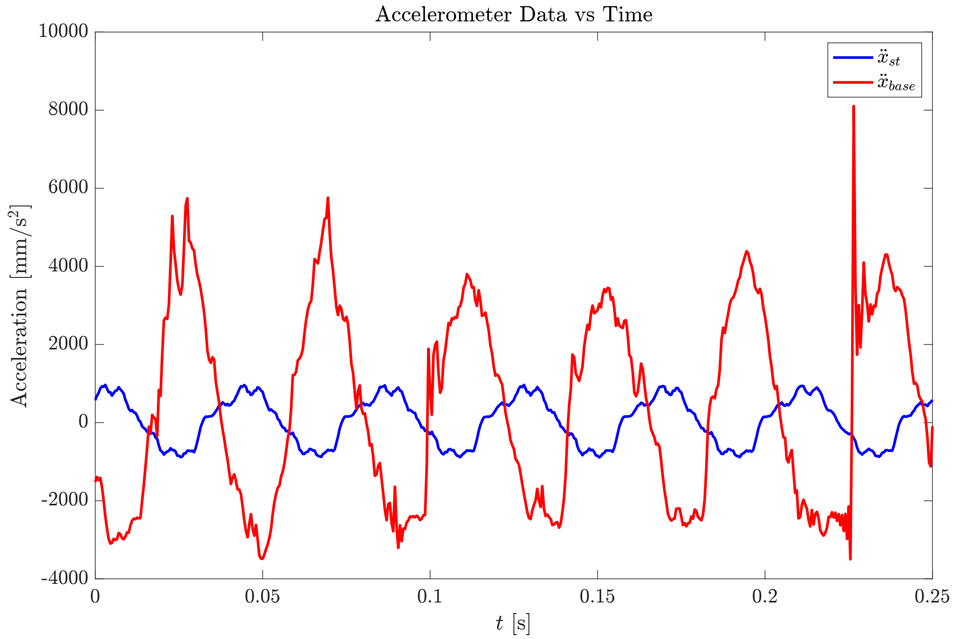

Figure - Experiment result for $f = 24$ Hz

Case 12 - $f = 26$ Hz

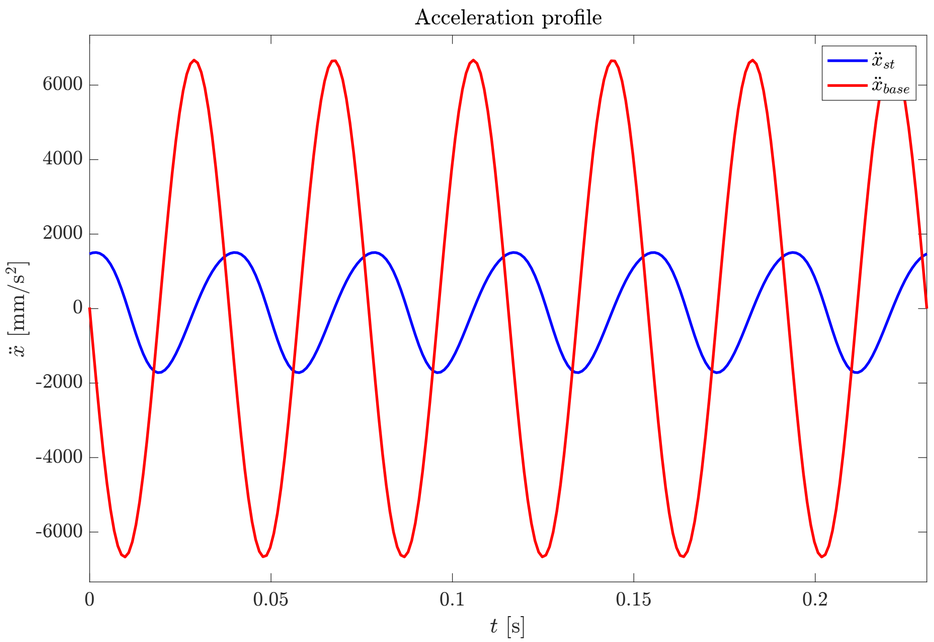

Figure - Simulation result for $f = 26$ Hz

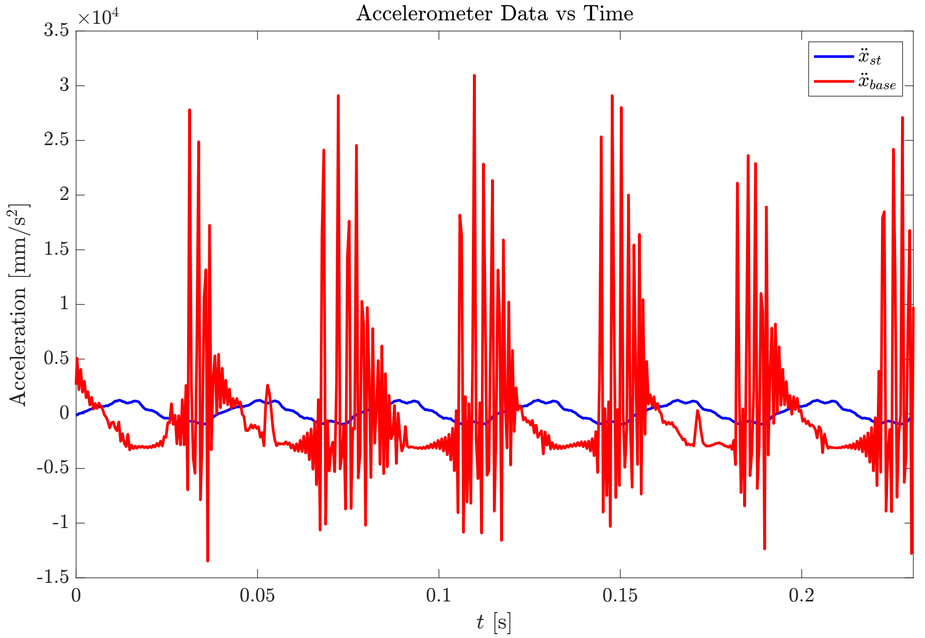

Figure - Experiment result for $f = 26$ Hz

Motion Transmissibility Comparison

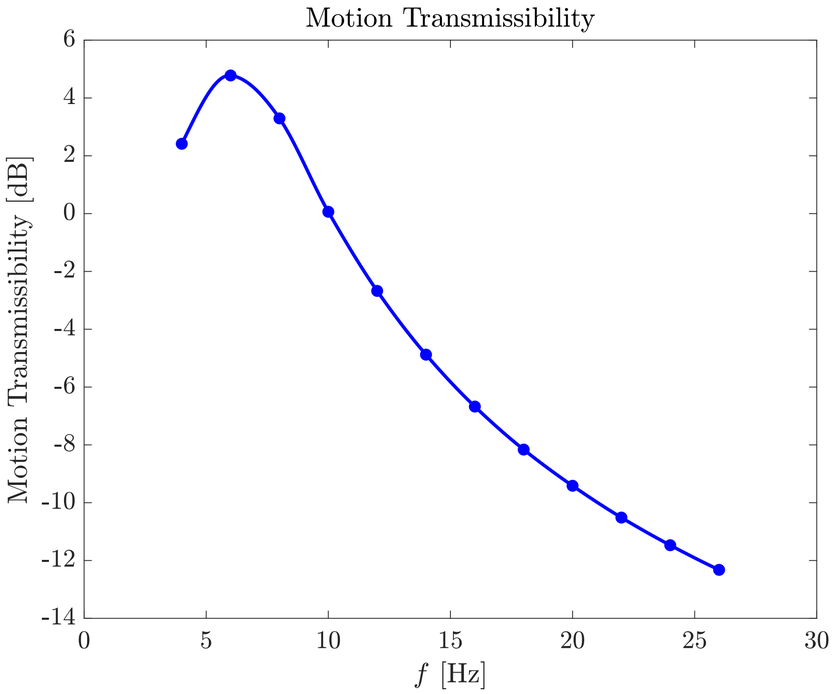

Figure - Simulated Motion Transmissibility Curve

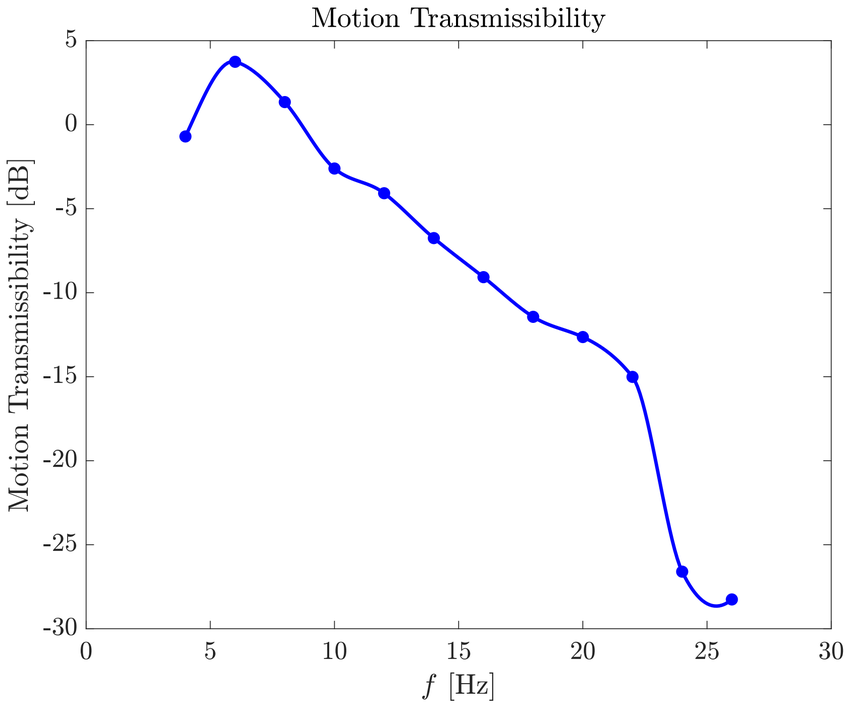

Figure - Experimental Motion Transmissibility Curve

Motion Transmissibility Comparison

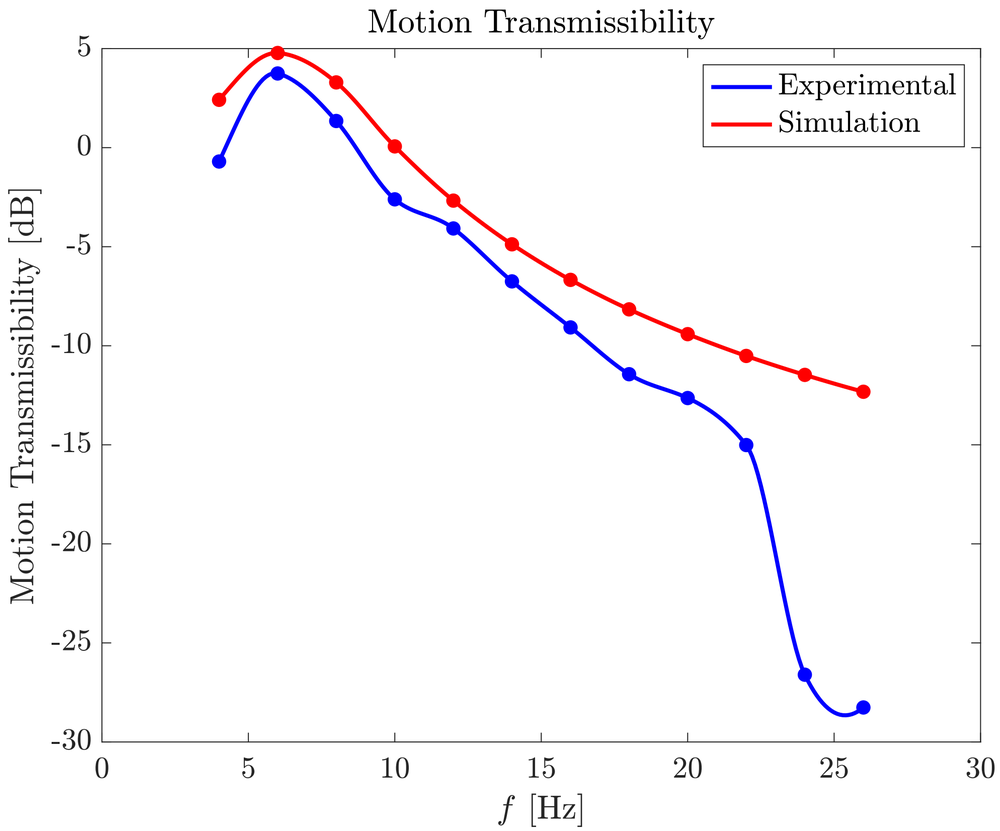

Figure - Comparison of Motion Transmissibility curves

Observations

- Better results compared to previous attempt, which highlights the importance of stiffness parameters. Scope for improvement

- Phase difference between simulation and experimental results

Future Work

- Simulate the dynamics using the actual input provided instead of sinusoidal base excitation, subject to some pre-processing