RIYA Week 7 Presentation

Comparison of Experimental Results with Simulation Results

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Tasks Accomplished

- Comparison of experimental and simulated **force-deflection curves**
- Obtained **time-domain** results for the two-spring stack system in the presence of base excitation (0.5 mm peak-to-peak amplitude) for **equilibrium ICs**
- Comparison of **experimental and simulation results** obtained for the **dynamics** of the two-spring stack system

Experimental and Simulated $F - x$ curves

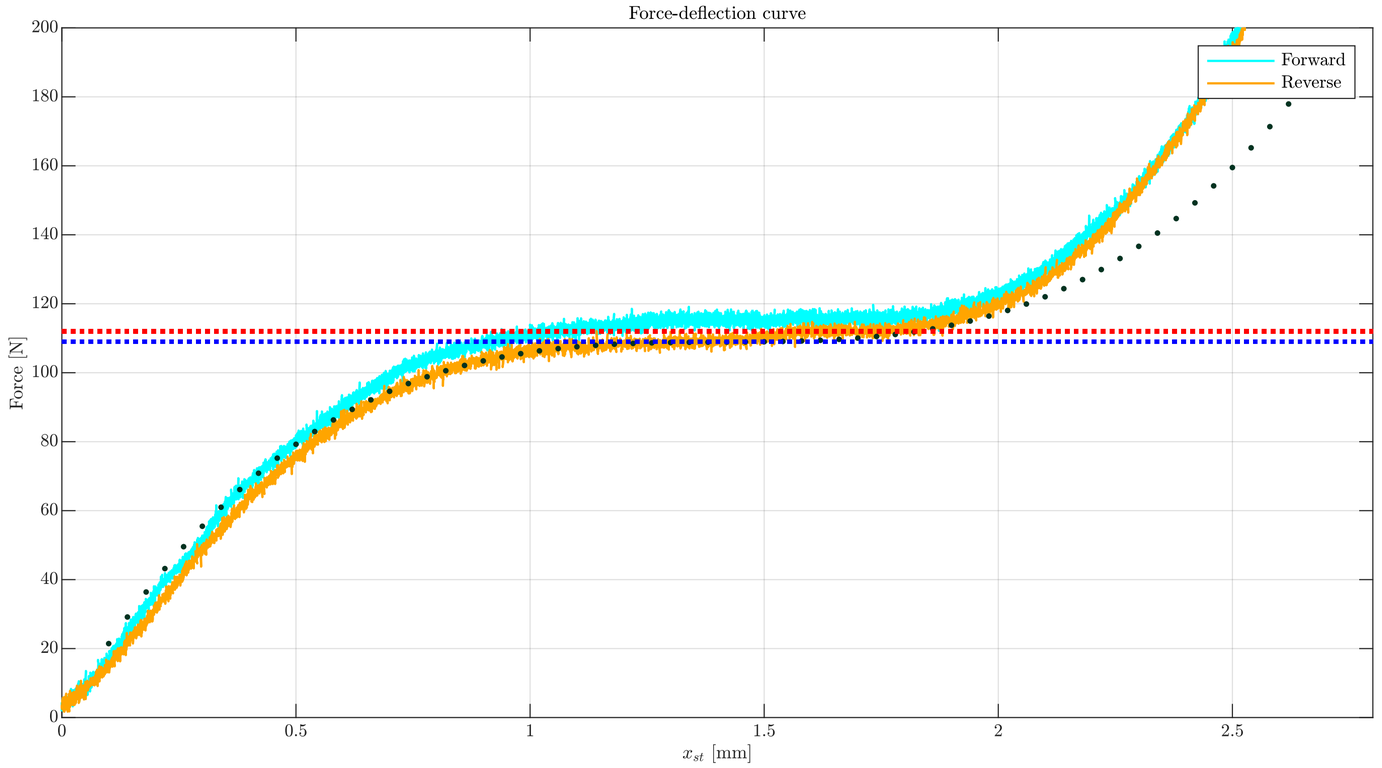


Figure 1 - Force deflection curve for $h_1/\tau = h_2/\tau = 1.41$

Red line - $m = 11.2$ kg

Blue line - $m = 10.9$ kg

Discrepancy in the post-QZS region of the simulated $F - x$ curve

Operating point sensitive to m and the $F - x$ curve shape

Thus, initial source of discrepancy between experiments and simulation

Possible reasons -
Neglecting effect of edge-friction coefficient

Experimental and Simulated $F - x$ curves

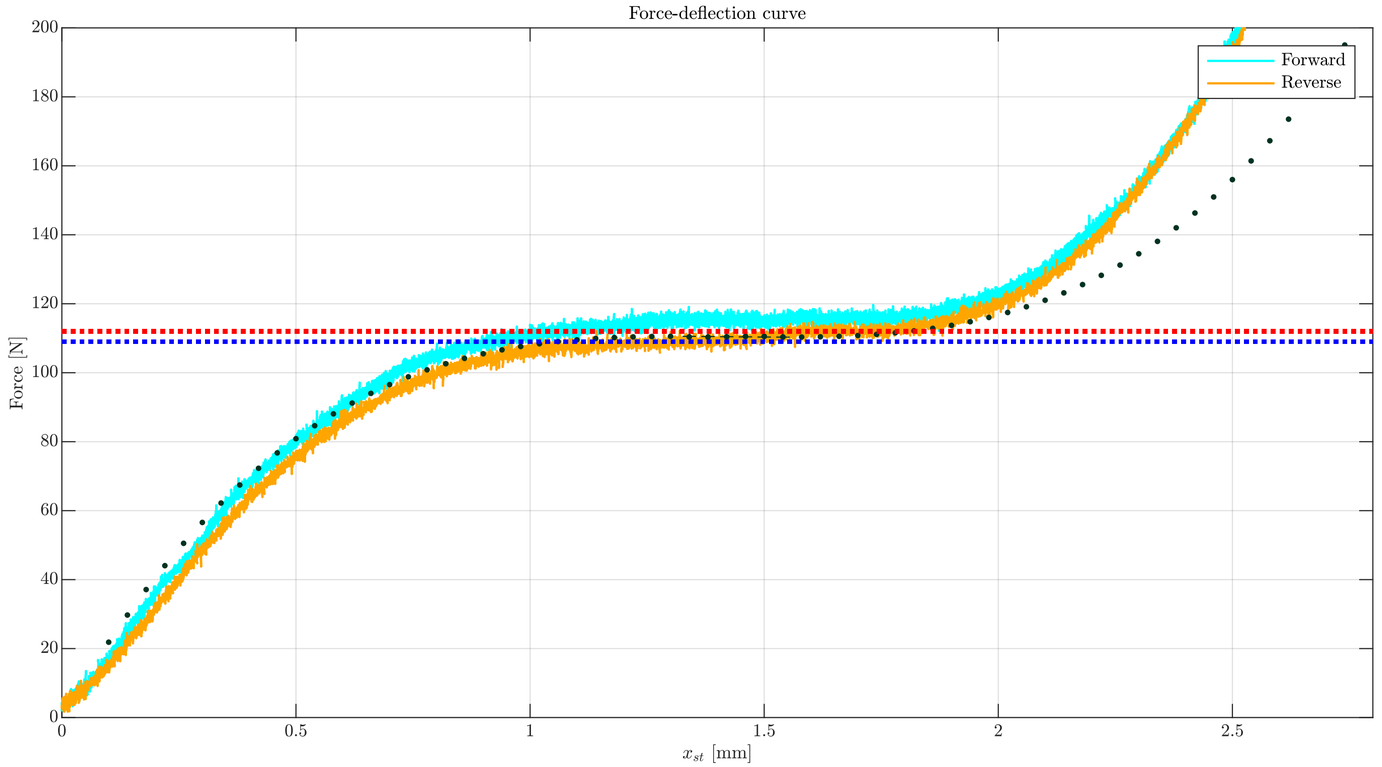
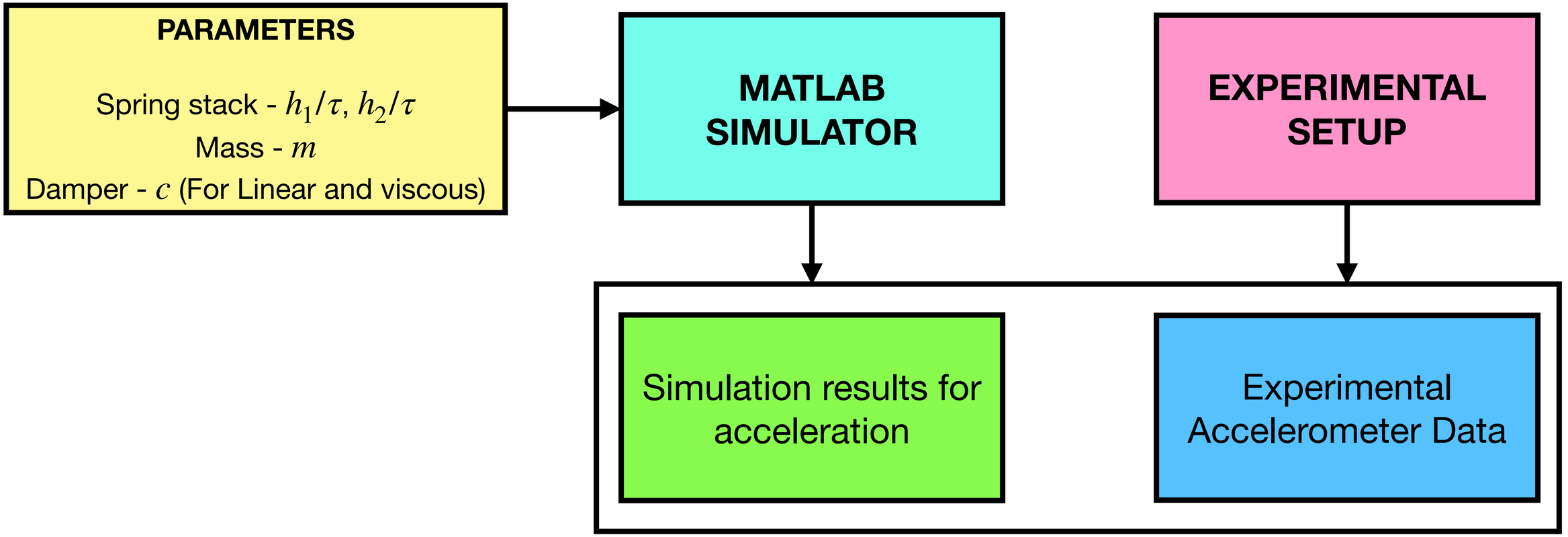


Figure 2 - Force deflection curve for $h_1/\tau = h_2/\tau = 1.43$

On increasing the h/τ ratio of both springs from 1.41 to 1.43, the $F - x$ curve **shifts up** slightly.

Thus, sensitivity of operating point to h/τ ratio

Matching Experimental and Simulated Dynamics



OBJECTIVE - Vary the parameters so that there is little discrepancy between the simulation and experimental results

Iterative Process ! **Need a starting point**

Simulation Process

STARTING PARAMETERS -

- $h_1/\tau = h_2/\tau = 1.41$
- $m = 11.2$ kg
- $c = 0.05$ Ns/mm
- $x_{base}(t) = 0.25 \sin(2\pi f t)$ (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

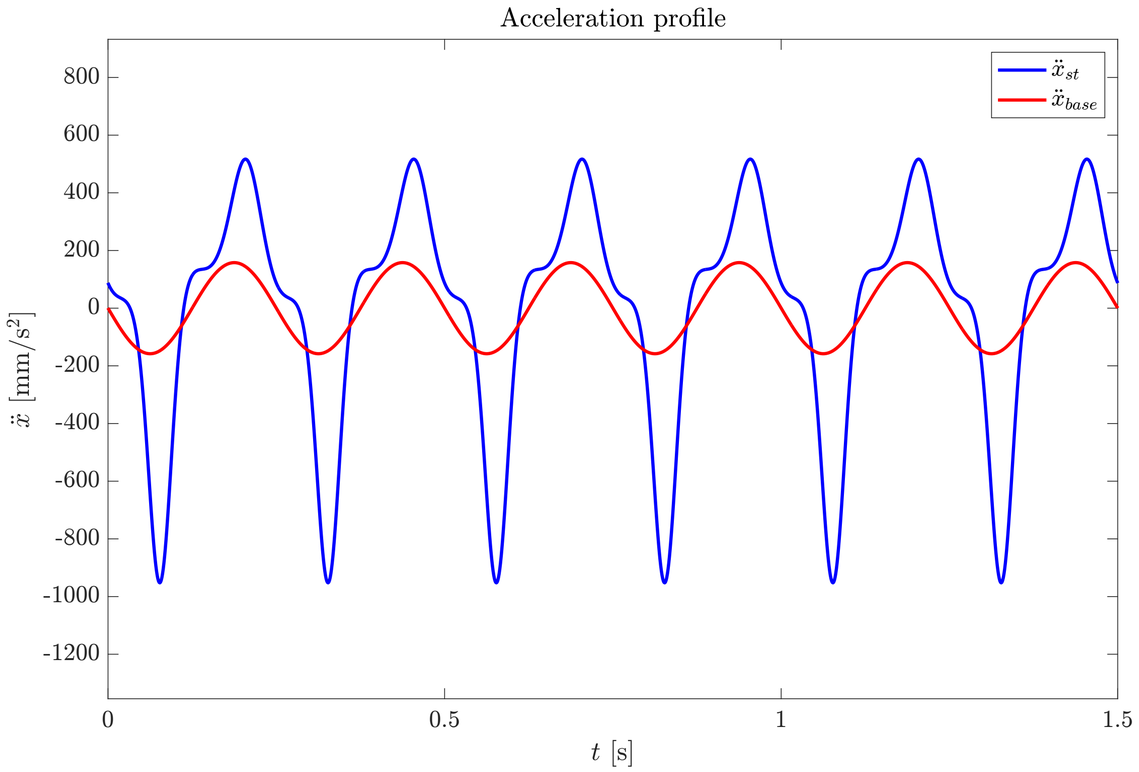


Figure - Simulation result for $f = 4$ Hz

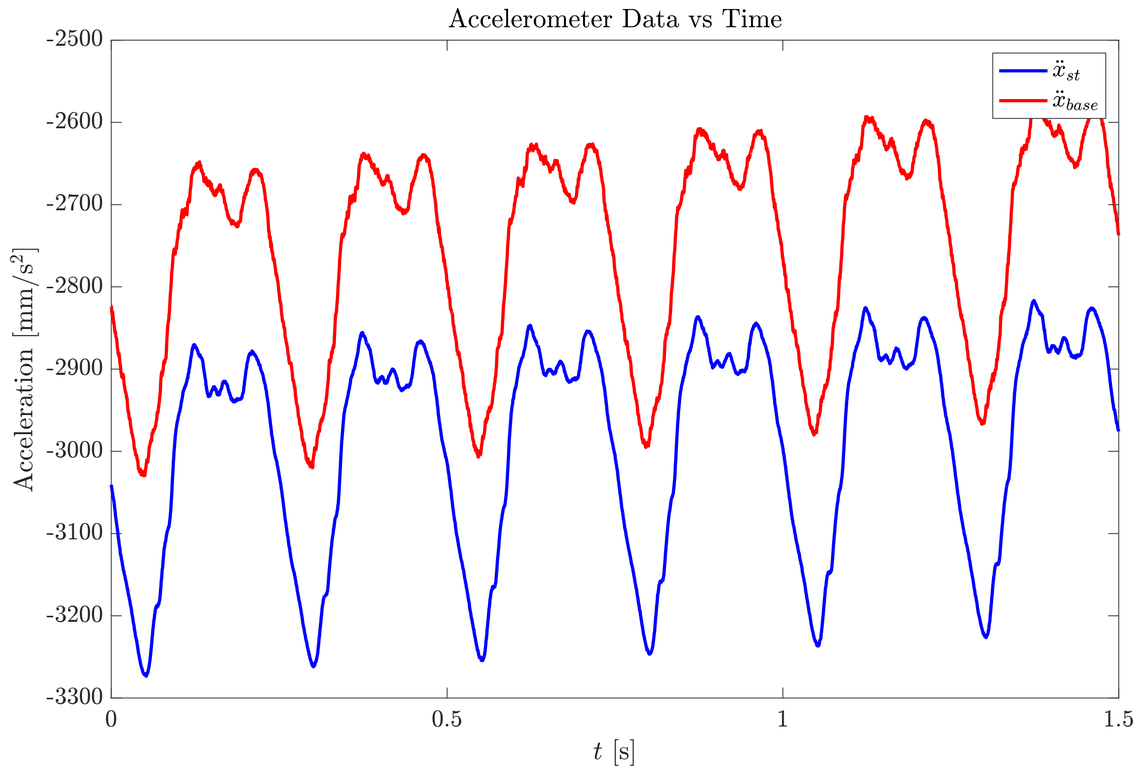


Figure - Experiment result for $f = 4$ Hz

Case 2 - $f = 6$ Hz

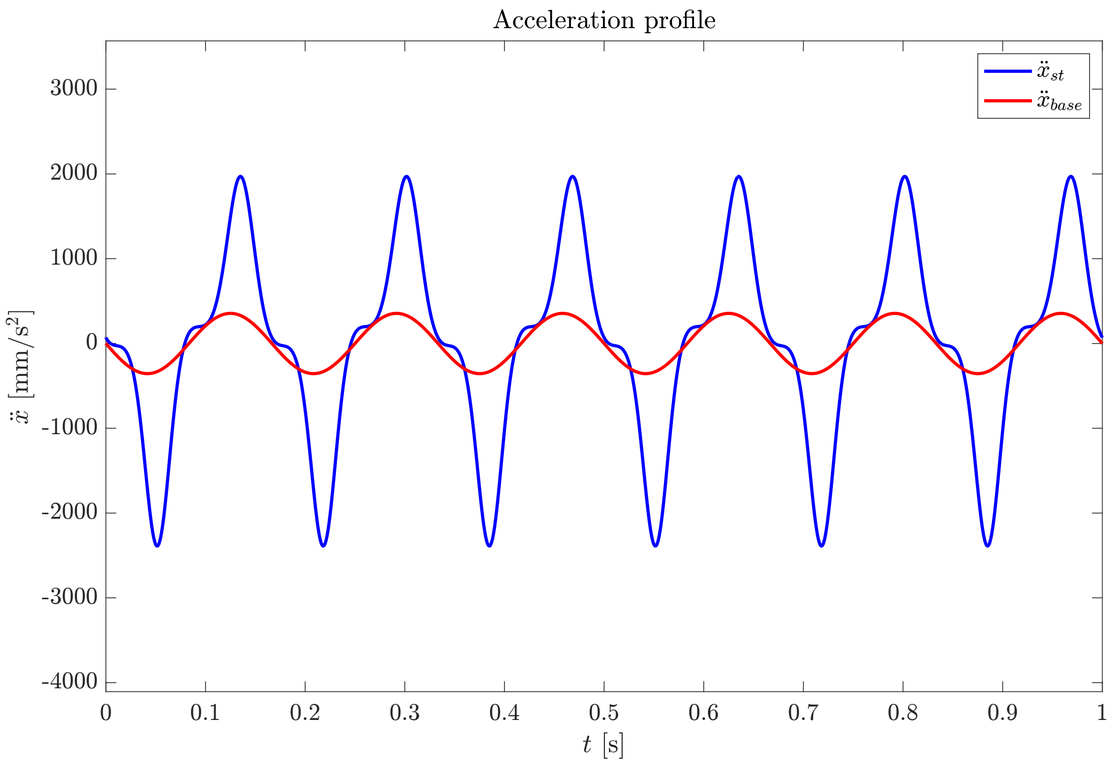


Figure - Simulation result for $f = 6$ Hz

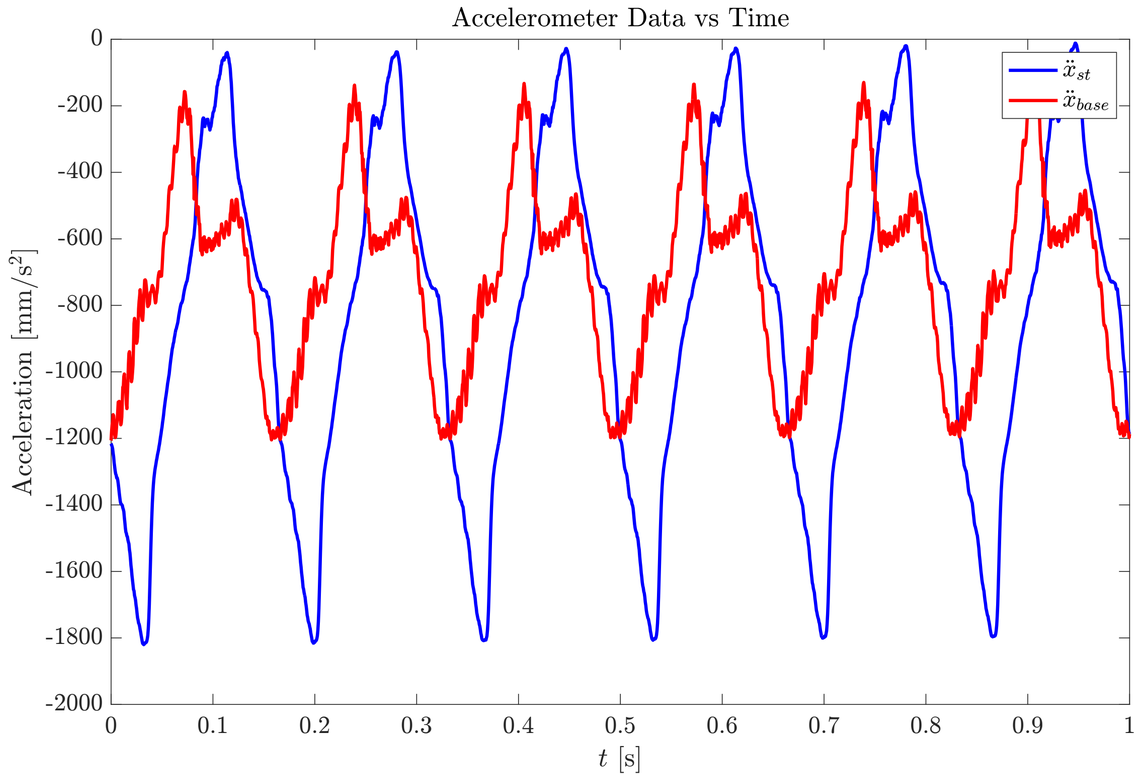


Figure - Experiment result for $f = 6$ Hz

Case 3 - $f = 8$ Hz

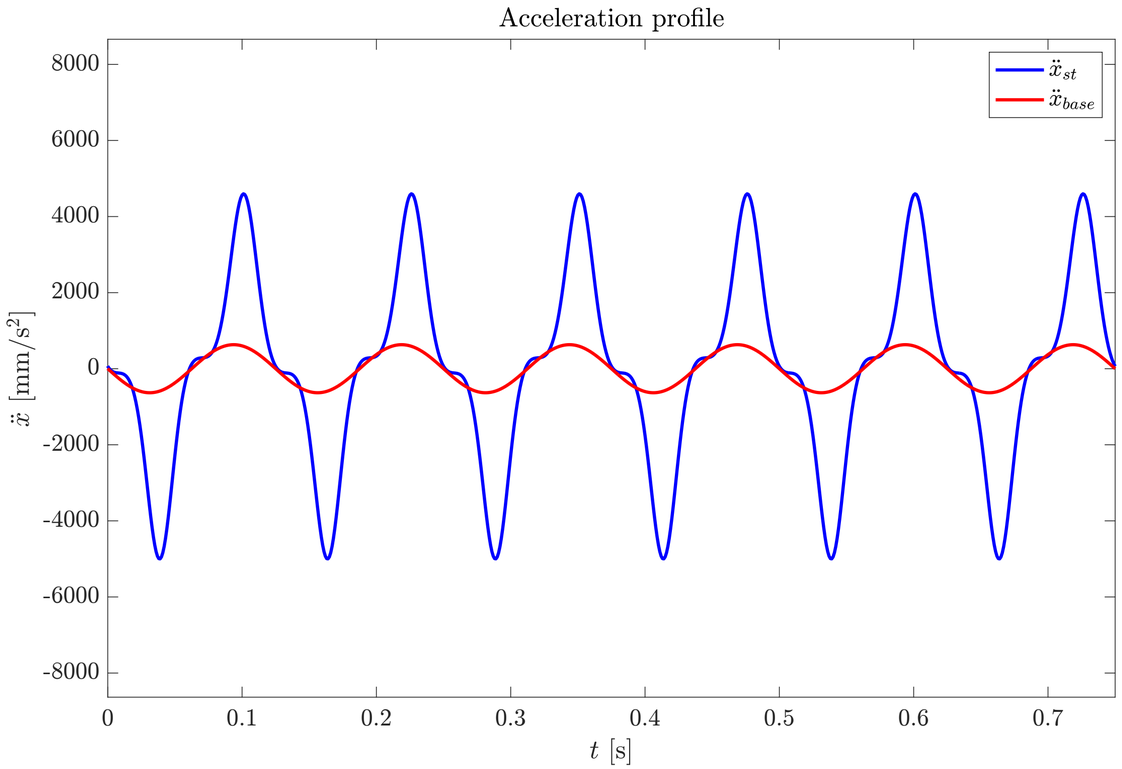


Figure - Simulation result for $f = 8$ Hz

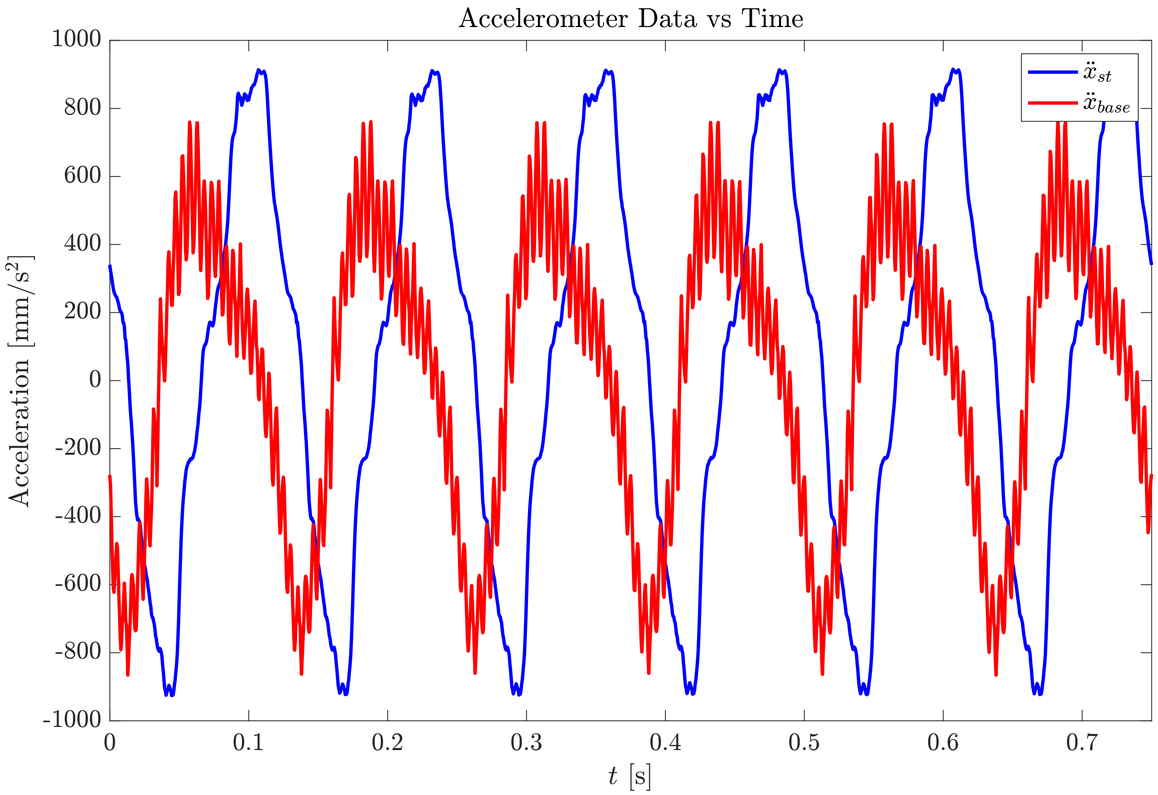


Figure - Experiment result for $f = 8$ Hz

Case 4 - $f = 10$ Hz

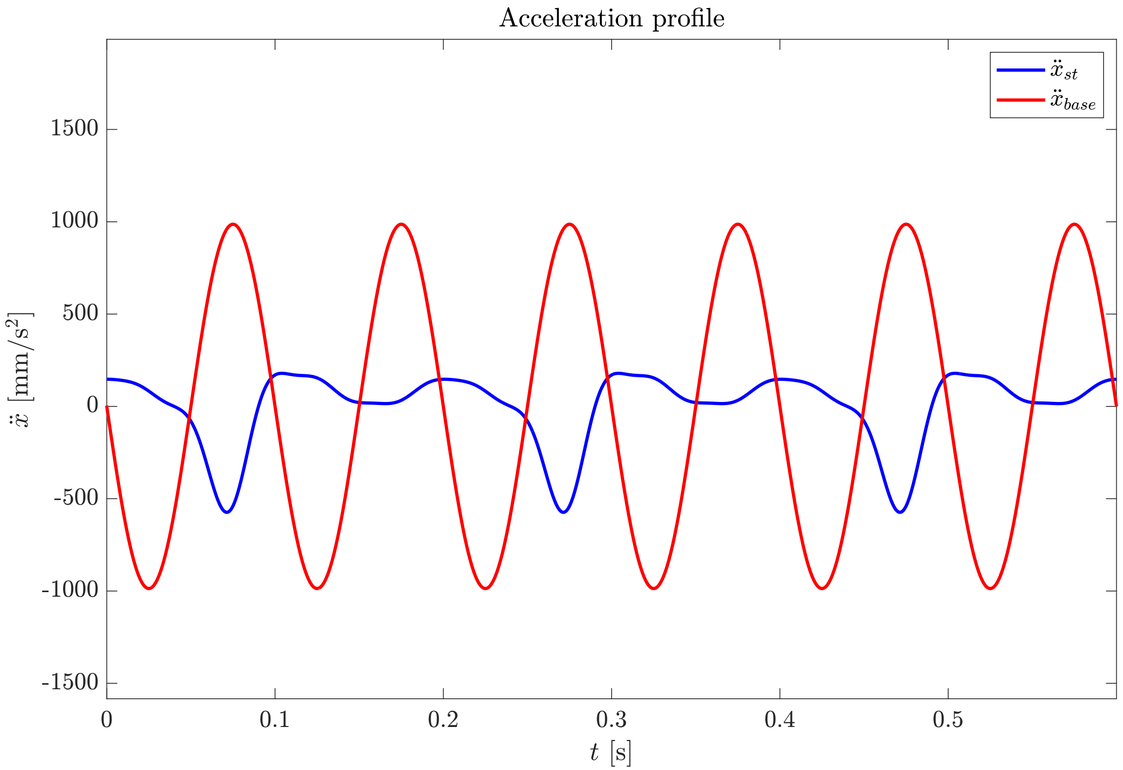


Figure - Simulation result for $f = 10$ Hz

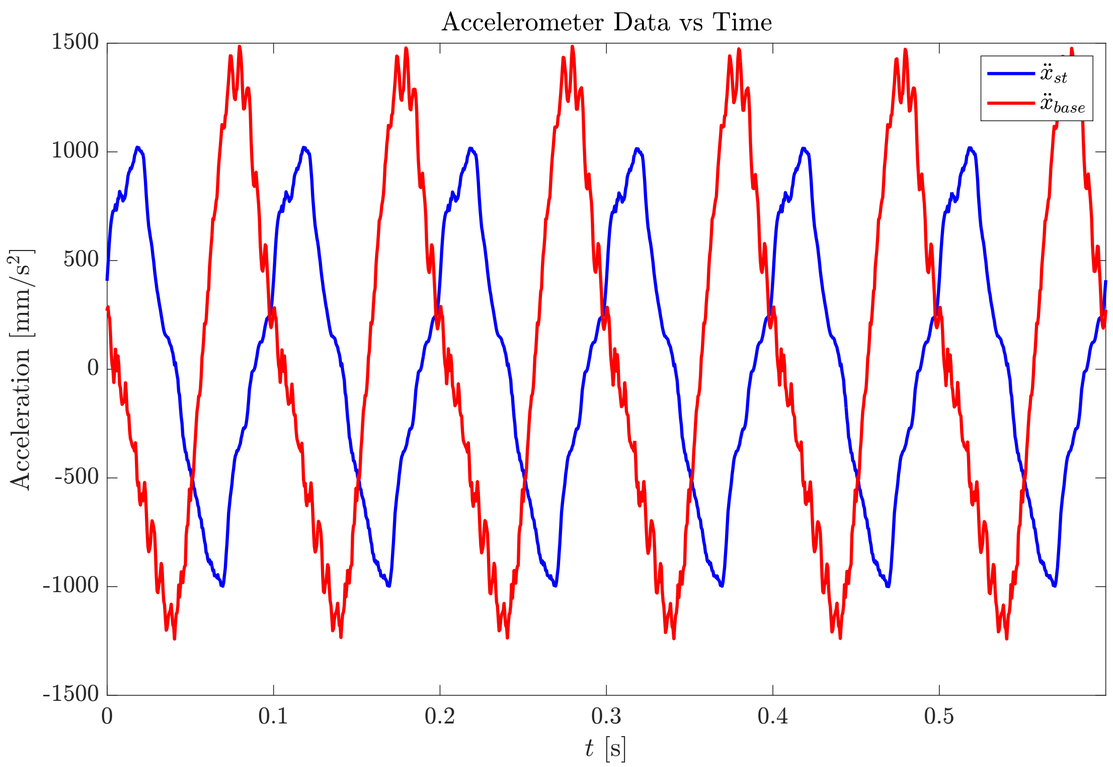


Figure - Experiment result for $f = 10$ Hz

Case 5 - $f = 12$ Hz

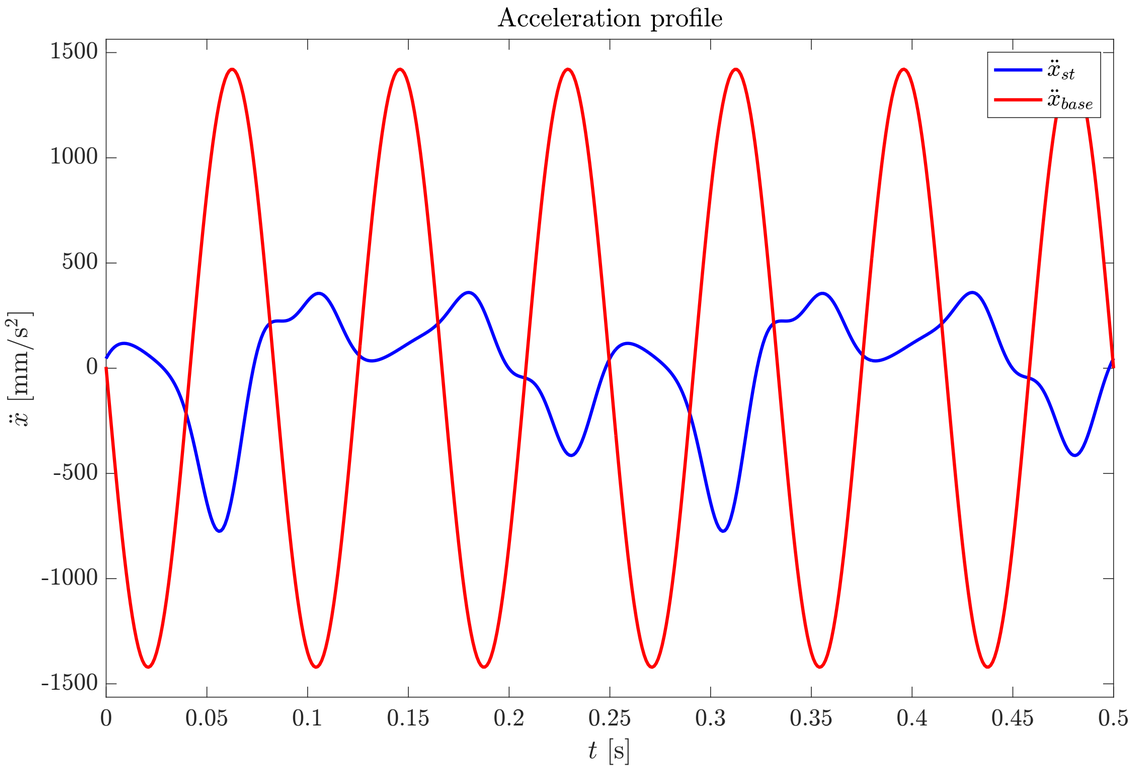


Figure - Simulation result for $f = 12$ Hz

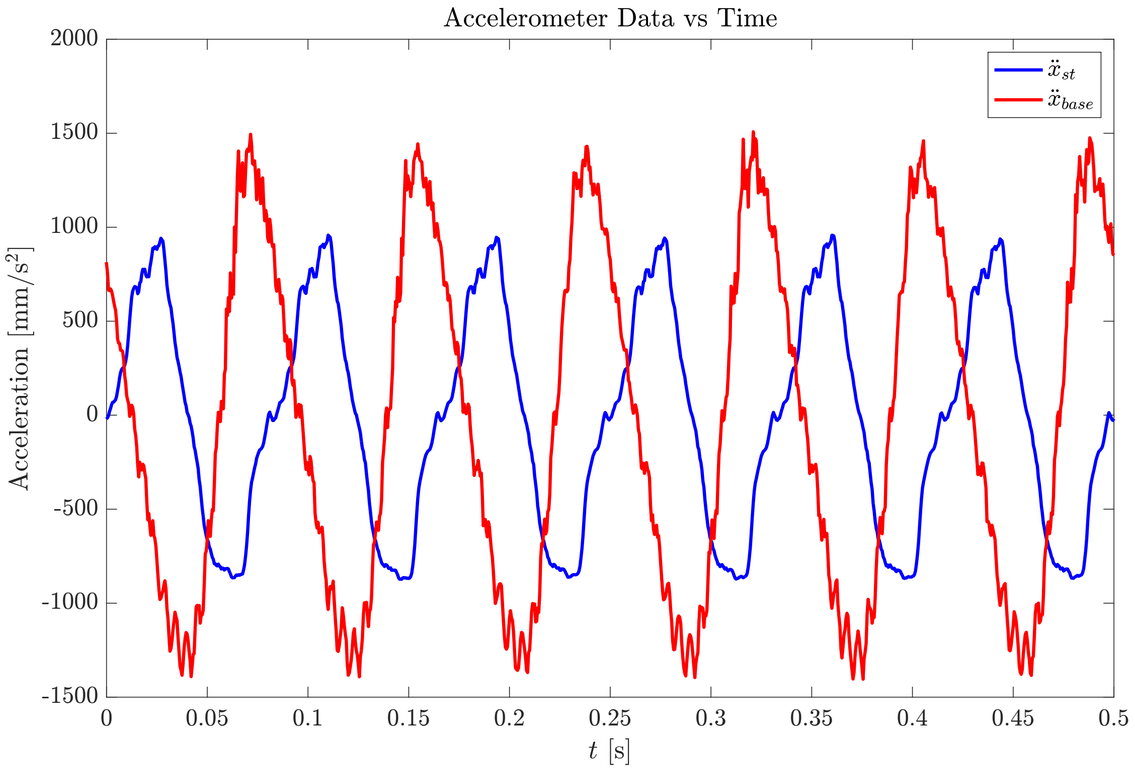


Figure - Experiment result for $f = 12$ Hz

Case 6 - $f = 14$ Hz

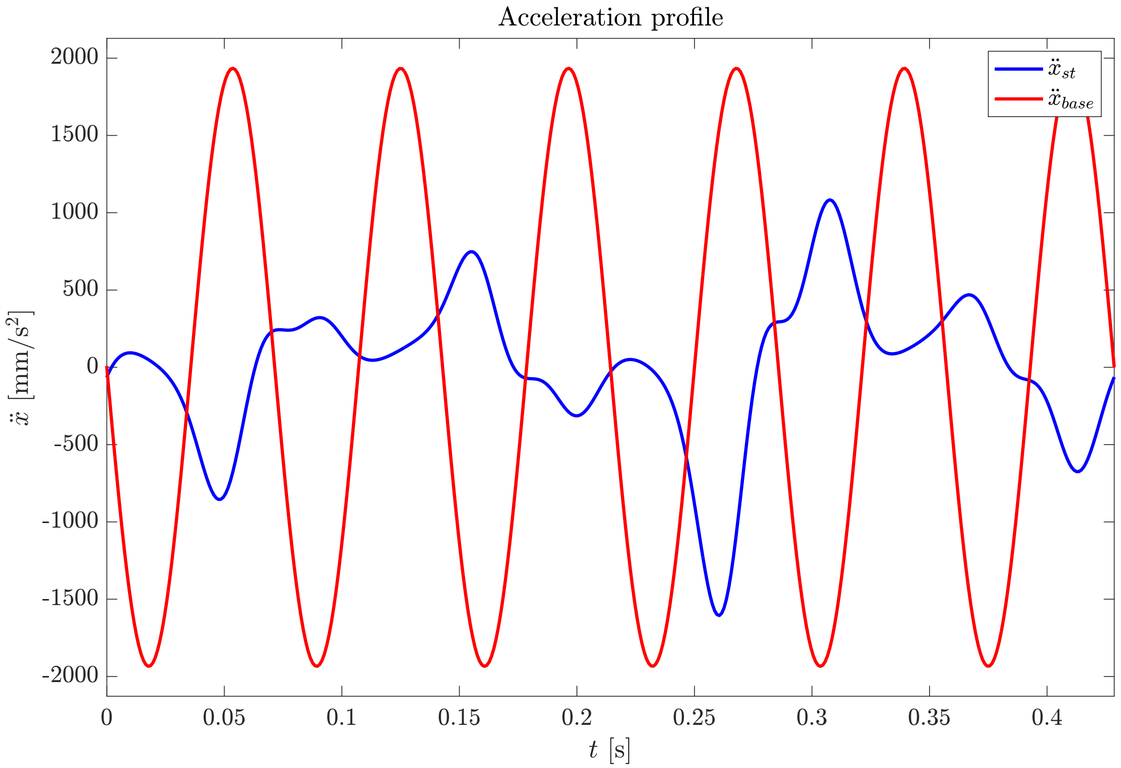


Figure - Simulation result for $f = 14$ Hz

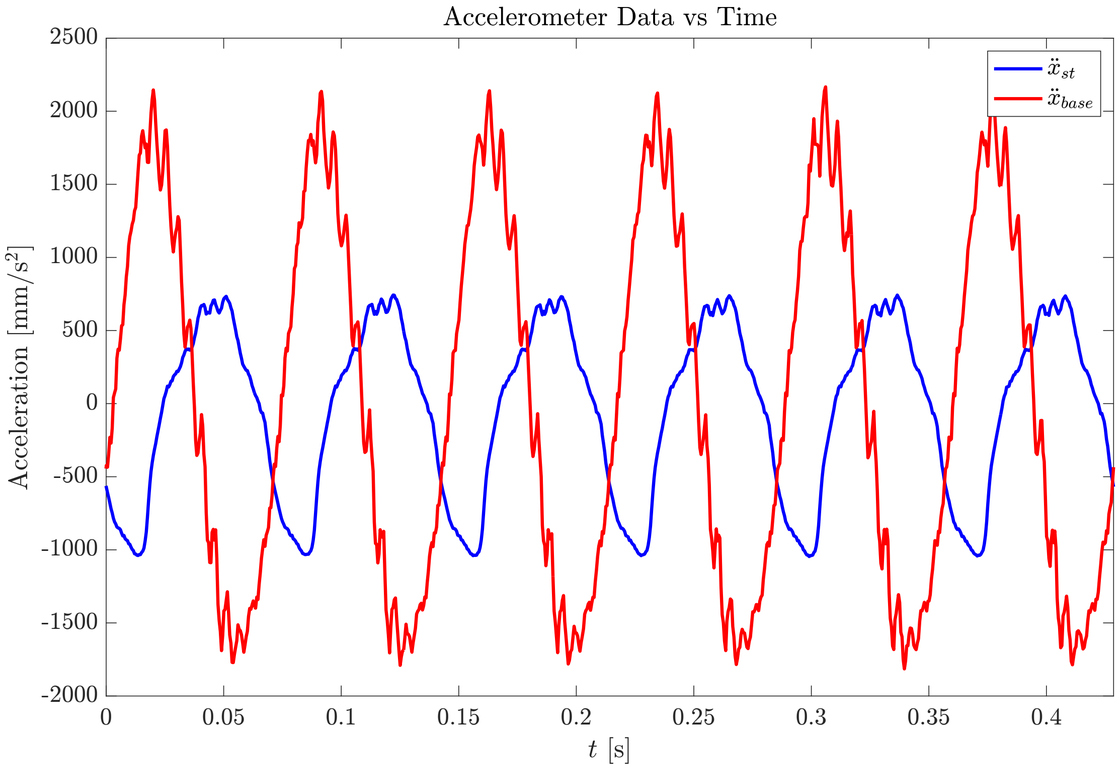


Figure - Experiment result for $f = 14$ Hz

Case 7 - $f = 16$ Hz

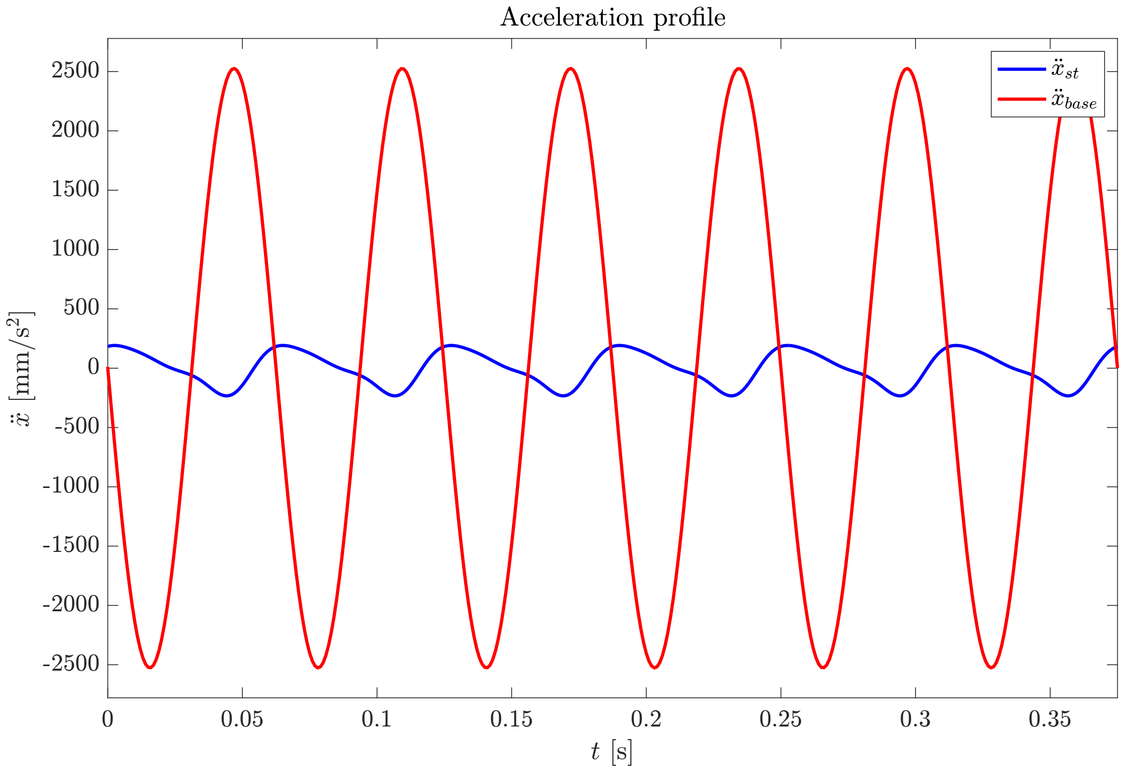


Figure - Simulation result for $f = 16$ Hz

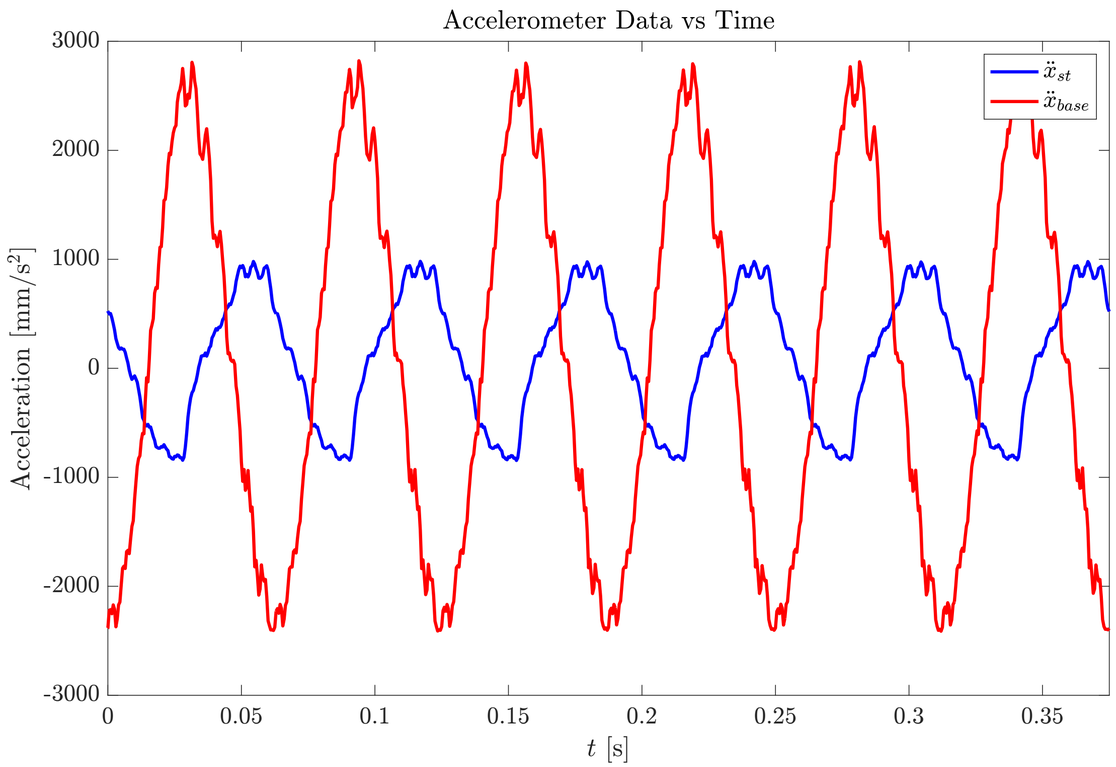


Figure - Experiment result for $f = 16$ Hz

Case 8 - $f = 18$ Hz

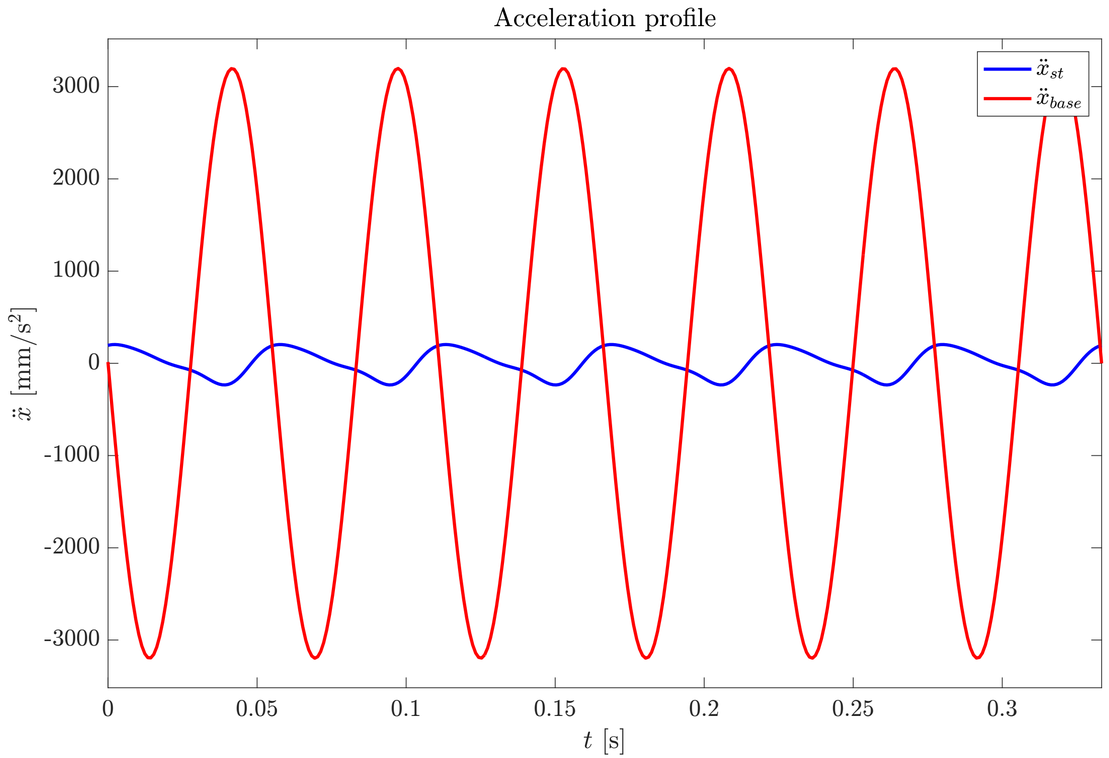


Figure - Simulation result for $f = 18$ Hz

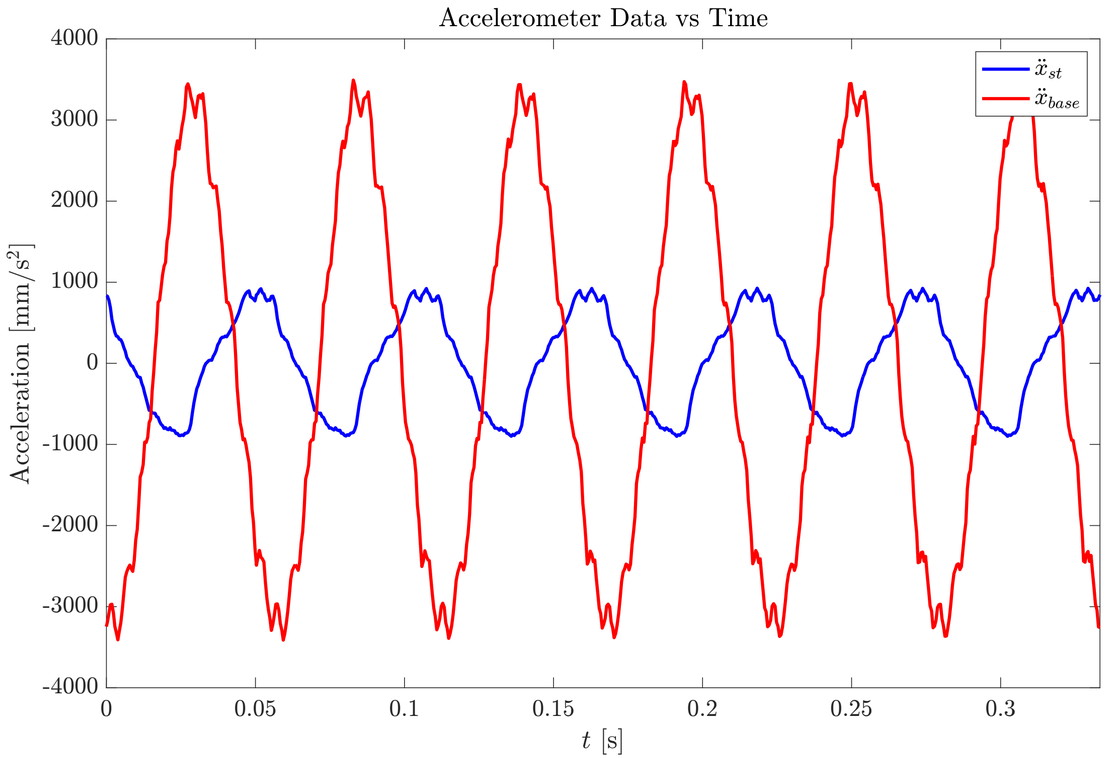


Figure - Experiment result for $f = 18$ Hz

Case 9 - $f = 20$ Hz

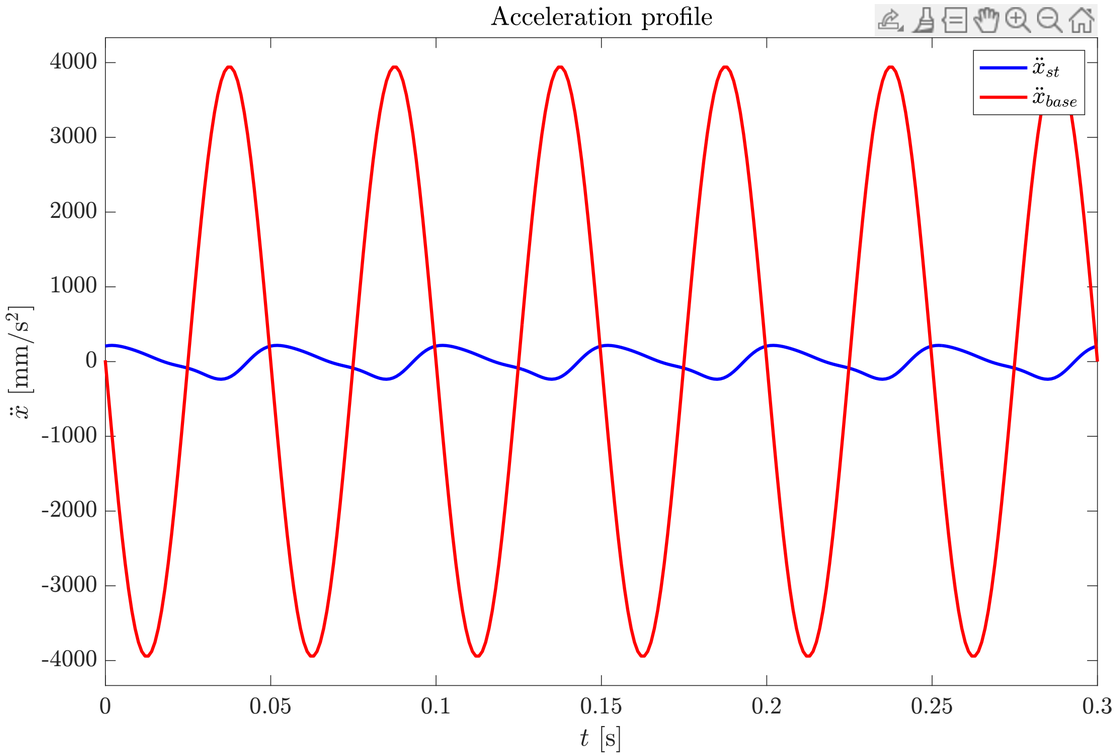


Figure - Simulation result for $f = 20$ Hz

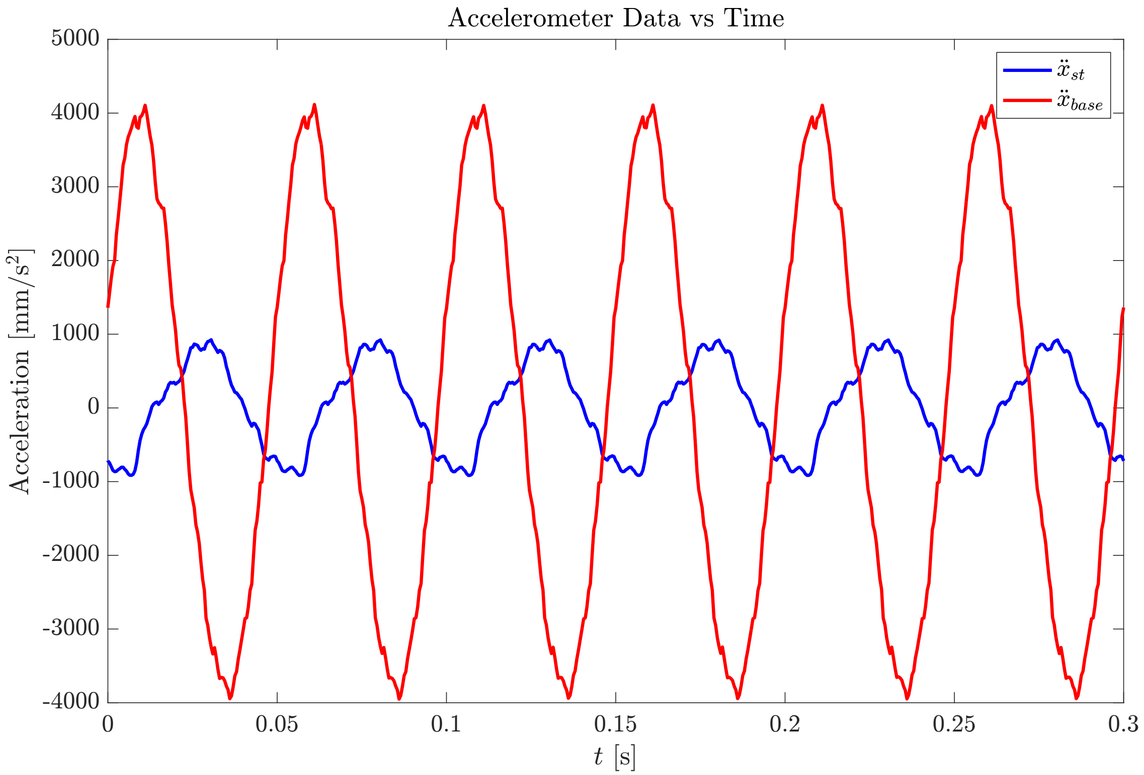


Figure - Experiment result for $f = 20$ Hz

Case 10 - $f = 22$ Hz

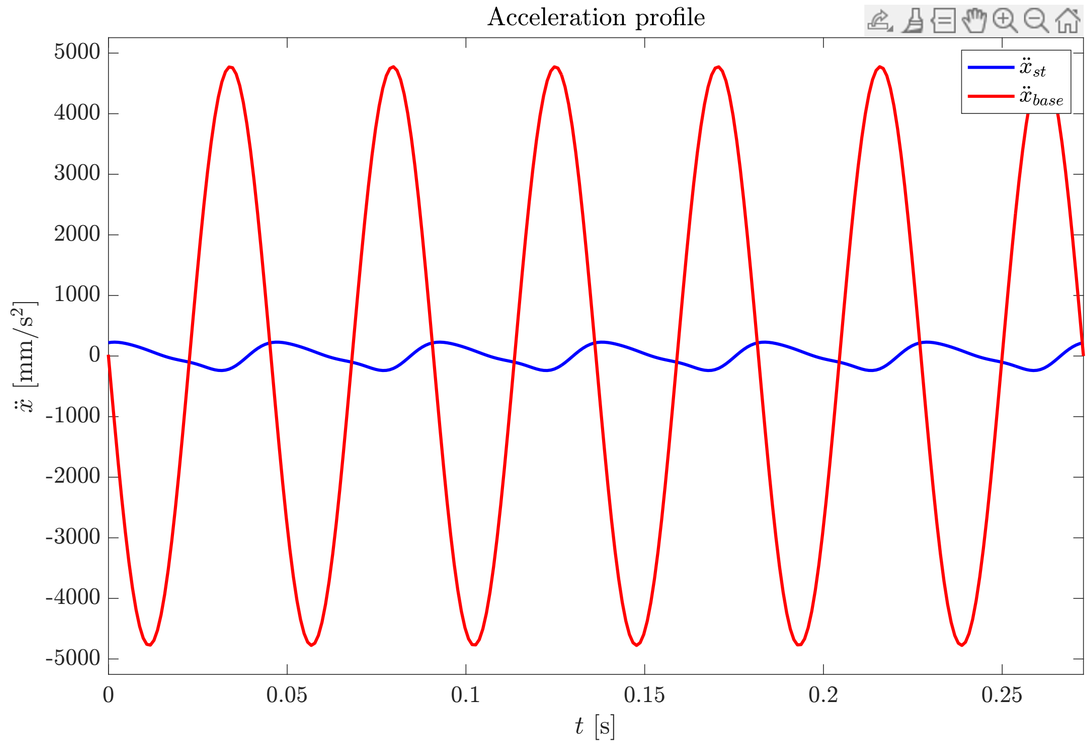


Figure - Simulation result for $f = 22$ Hz

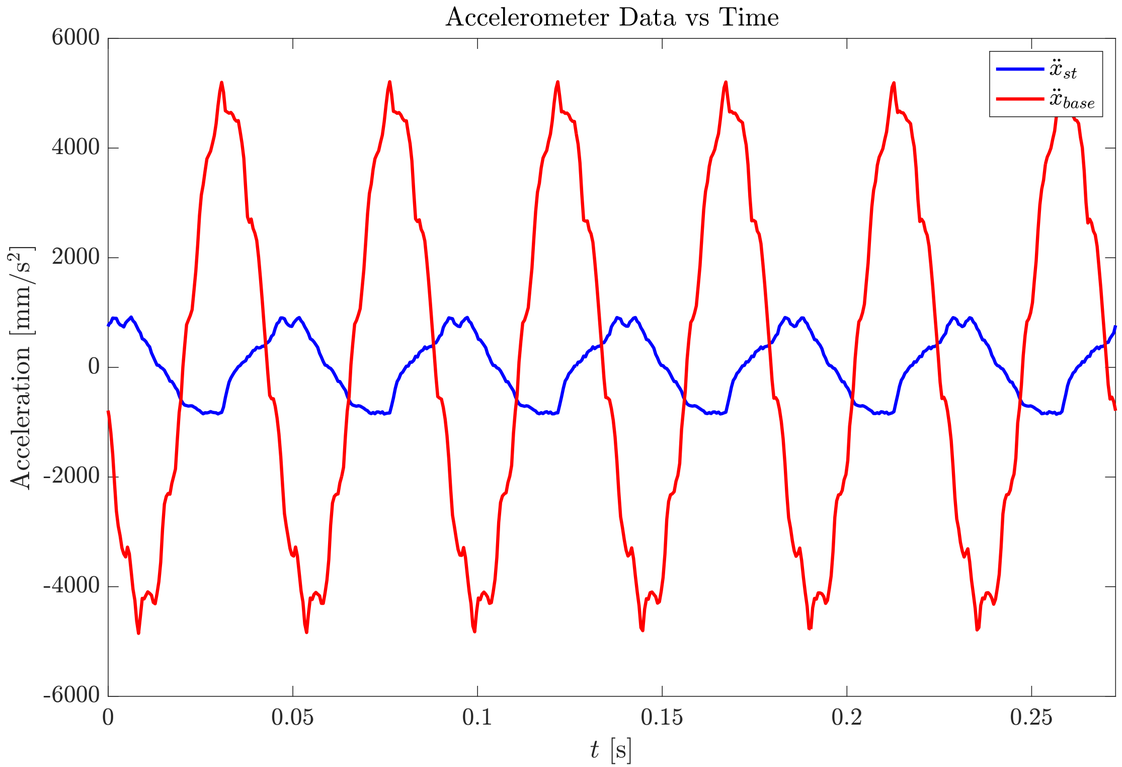


Figure - Experiment result for $f = 22$ Hz

Case 11 - $f = 24$ Hz

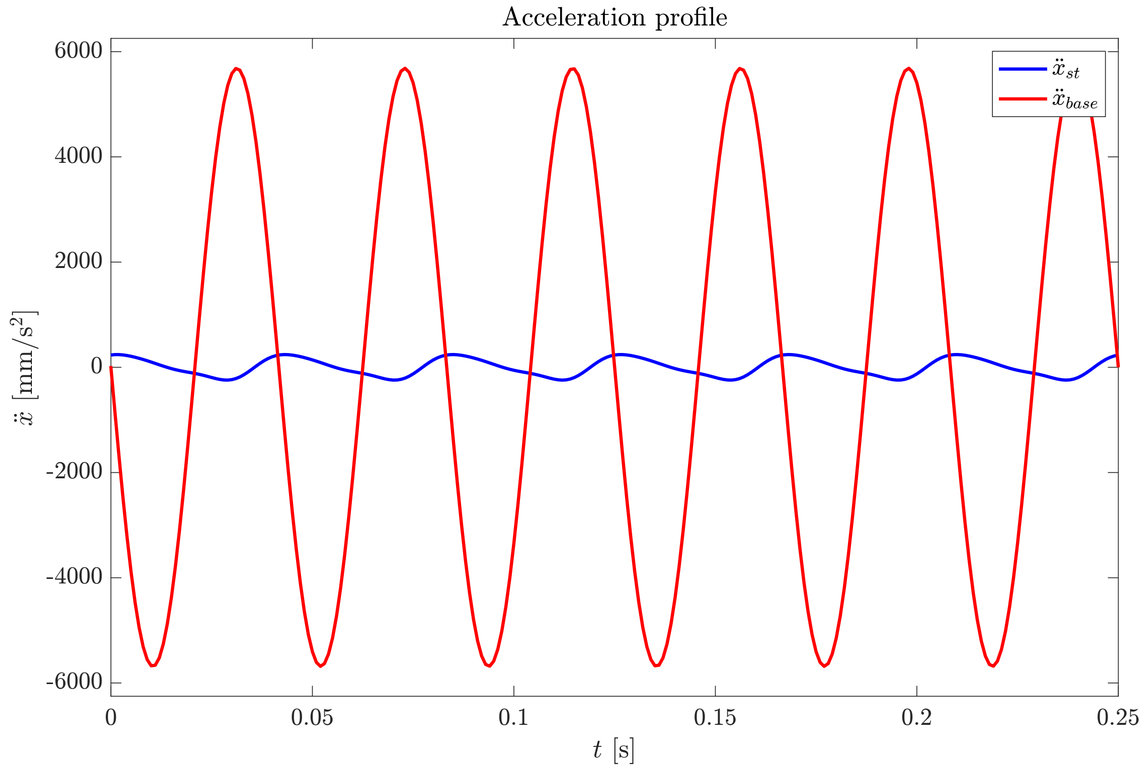


Figure - Simulation result for $f = 24$ Hz

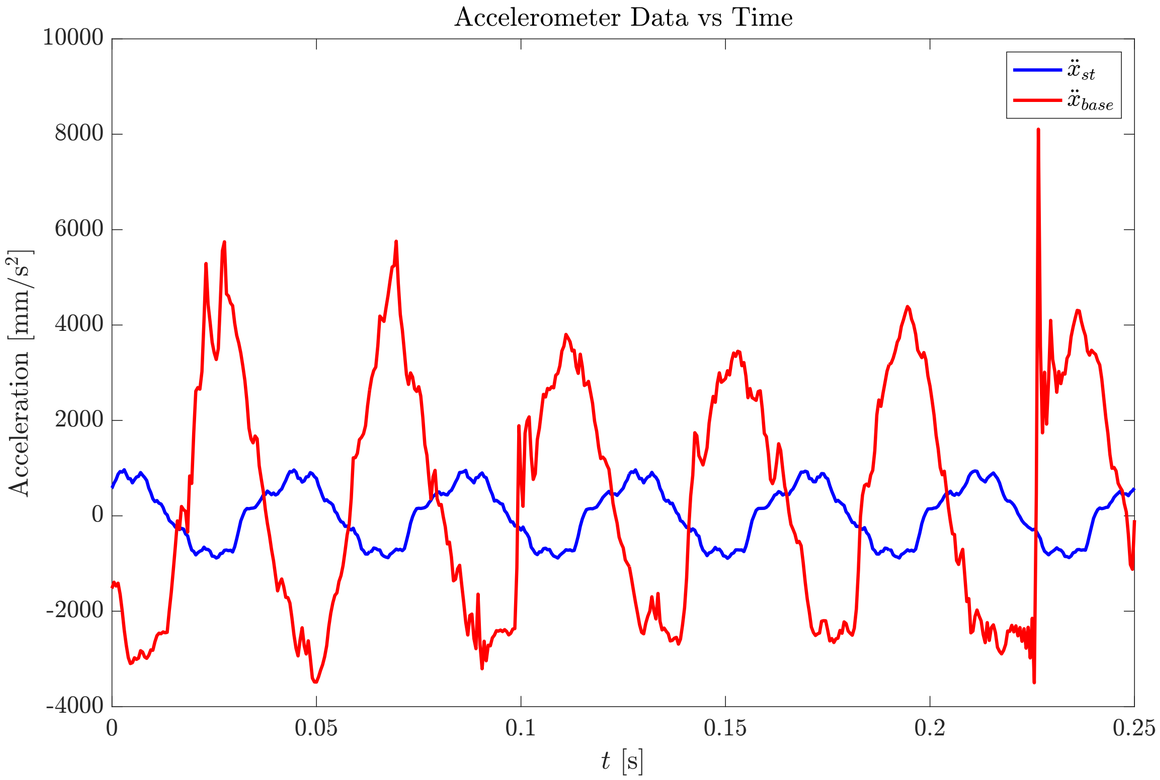


Figure - Experiment result for $f = 24$ Hz

Case 12 - $f = 26$ Hz

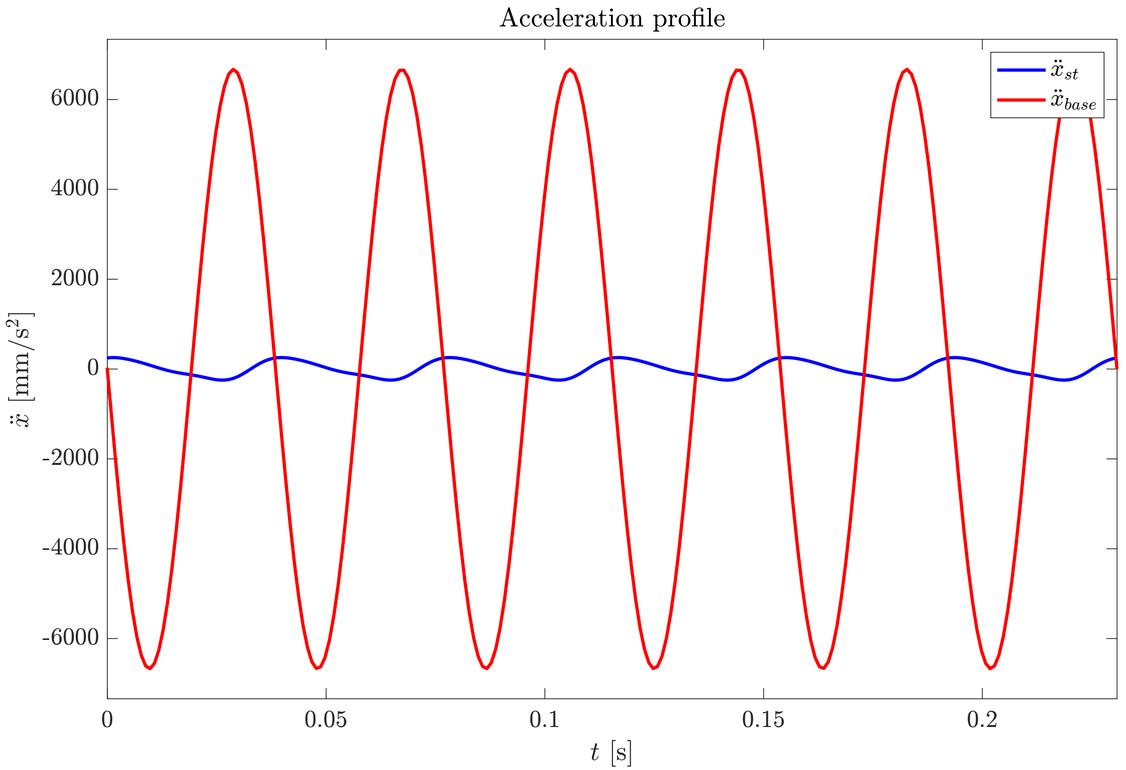


Figure - Simulation result for $f = 26$ Hz

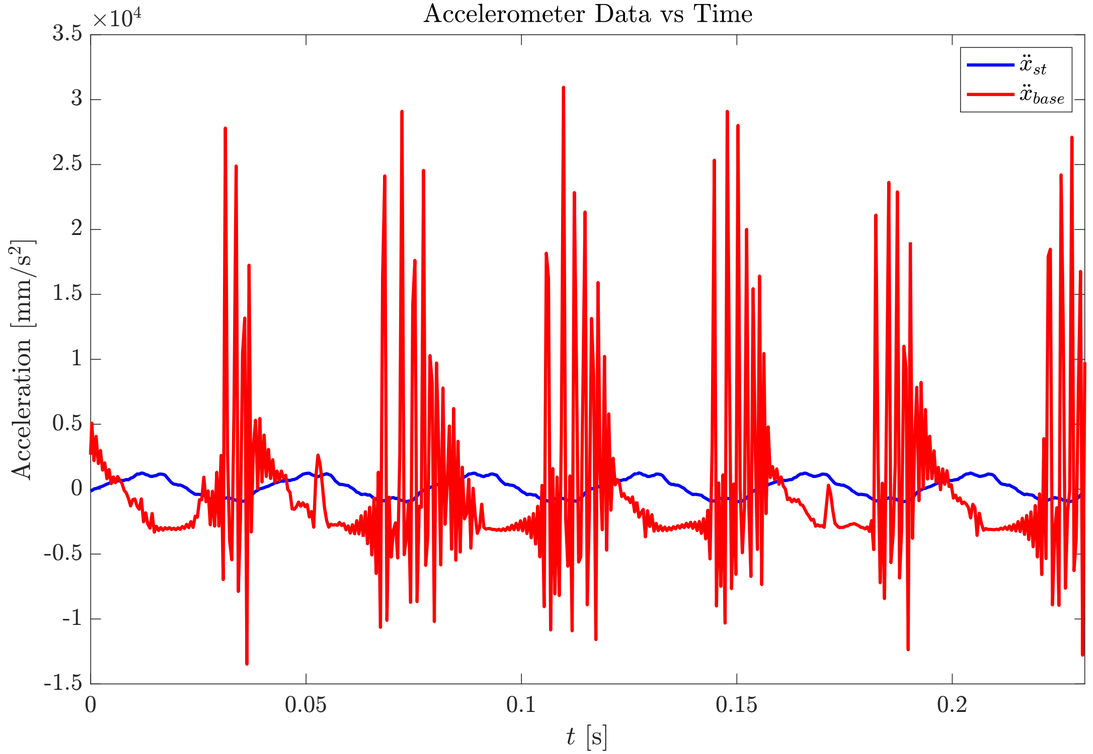


Figure - Experiment result for $f = 26$ Hz

Observations

- Huge discrepancy between experimental and simulation results for the given starting parameters
- In certain cases, the base excitation signal deviates significantly from a sinusoidal input

Future Work

- Data Pre-processing
- Simulate the dynamics using the actual input provided instead of sinusoidal base excitation
- Investigate how to vary the spring and damping parameters for better match between simulation and experimental results. **Effect of damping** needs to be **increased** possibly.