PNLSS Identification

Post TRC Institute Meeting 3

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Progress on Benchmark 1 (Duffing Oscillator)

Overview

- Conducted PNLSS with different amplitude levels (as before)
- Constructed frequency response with PNLSS model
- Synthesized frequency response with identified data from simulated experiments from Eve (without shaker model)

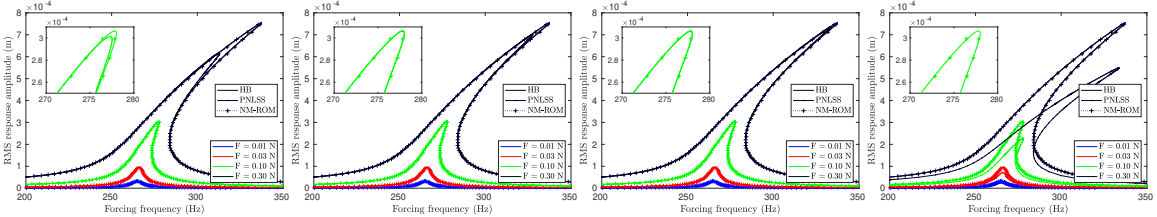
To Do:

- Consider shaker model

Progress on Benchmark 1 (Duffing Oscillator) I

Frequency Response Comparisons

(Non-periodic)



(a) A=0.01 N (b) A=0.25 N (c) A=0.50 N (d) A=0.75 N

Progress on Benchmark 4 (Beam with friction)

Overview

- Conducted PNLSS with different amplitude levels (as before)
- Constructed frequency response with PNLSS model (!)
  - This was found to be extremely sensitive to the continuation parameters
  - In order to get decent figures I had to use the previous version of nlvib (2017), which had a slightly different terminator condition
- Synthesized frequency response from simulated PLL experiments from Eve (without shaker)
  - She's given me the codes for doing it with the shaker, I just need to add the shaker model for the transient simulations
  - Should be good to go soon

To Do:

- Employ PLL data for PNLSS identification
- Identify approaches to reduce amplitude dependence
  - Currently looking into triangle-modulated multi-sines (sawtooths were leaking too much)

Progress on Benchmark 4 (Beam with friction) I

PNLSS training (vanilla version)

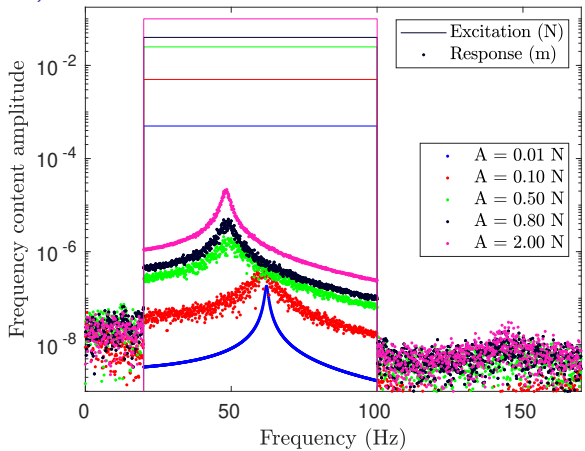
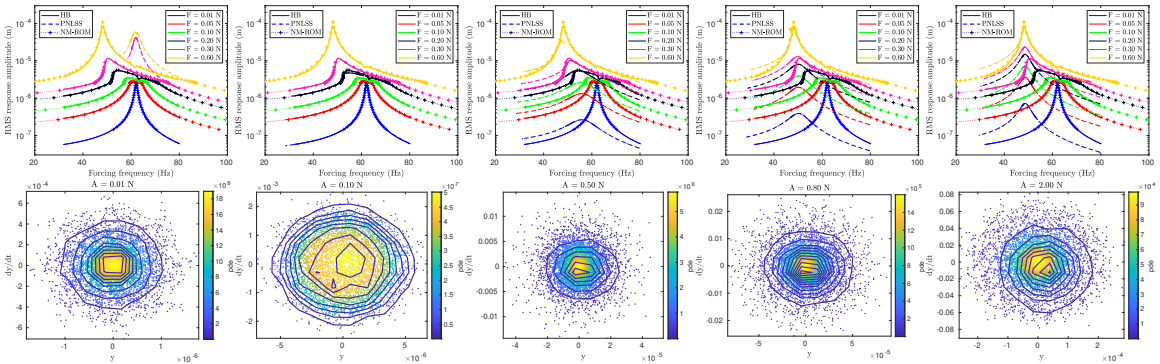


Figure: Frequency content of different multi-sine responses showing stick-slip.

Progress on Benchmark 4 (Beam with friction) II

PNLSS training (vanilla version)



(a) A = 0.001 N (b) A = 0.01 N (c) A = 0.05 N (d) A = 0.08 N (e) A = 0.20 N

Progress on Benchmark 4 (Beam with friction)

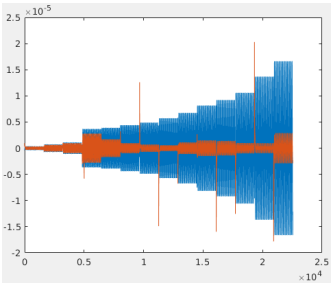
Emloying PLL Data for PNLSS Identification

Approach so far:

- Use low amplitude multi-sine data for BLA initialization
- Use PLL data for PNLSS identification

Problem:

- Unable to get optimization to reduce error sufficiently well. Best I could get:



Progress on Benchmark 4 (Beam with friction) I

Circumventing Amplitude De

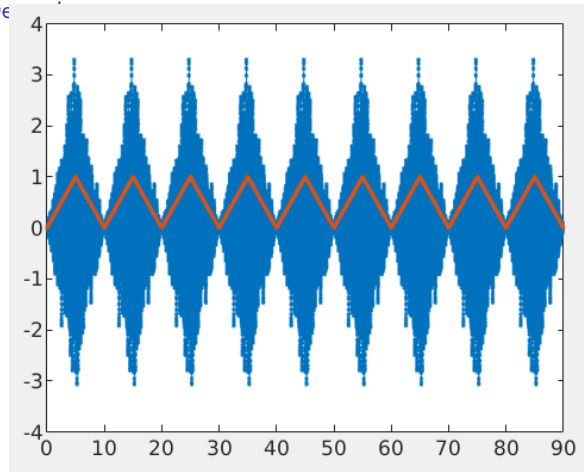


Figure: Triangle-modulated multi-sine

Progress on Benchmark 4 (Beam with friction) II

Circumventing Amplitude Dependence

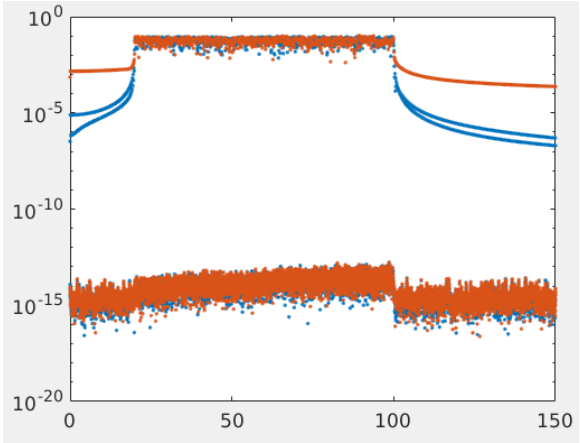


Figure: Leakage: triangle vs sawtooth

Outlook

At this point, I think it makes sense to determine the primary focus for each benchmark. I have made the following list based on what makes sense to me and would like to discuss on it:

Benchmark 1 (Geometrically non-linear beam modeled as SDOF Duffing oscillator)
The focus could be capturing the stiffening non-linearity.

Benchmark 2 (MDOF model with cubic non-linearities)
The focus could be capturing 2/3 modes simultaneously. PNLSS could be trained using multisines with bands limited around multiple modes at the same time (we already have initial results from the summer).

Benchmark 3 (MDOF model with softening-stiffening non-linearity)
The focus could be capturing the softening-stiffening effect for mode 1 alone.

Benchmark 4 (E-B Beam with frictional node)
The focus could be capturing the dampening-softening effect for mode 1 alone.

Benchmark 5 (E-B Beam with unilateral contacting node)
The focus could be capturing the contacting-stiffening effect for mode 1 alone.