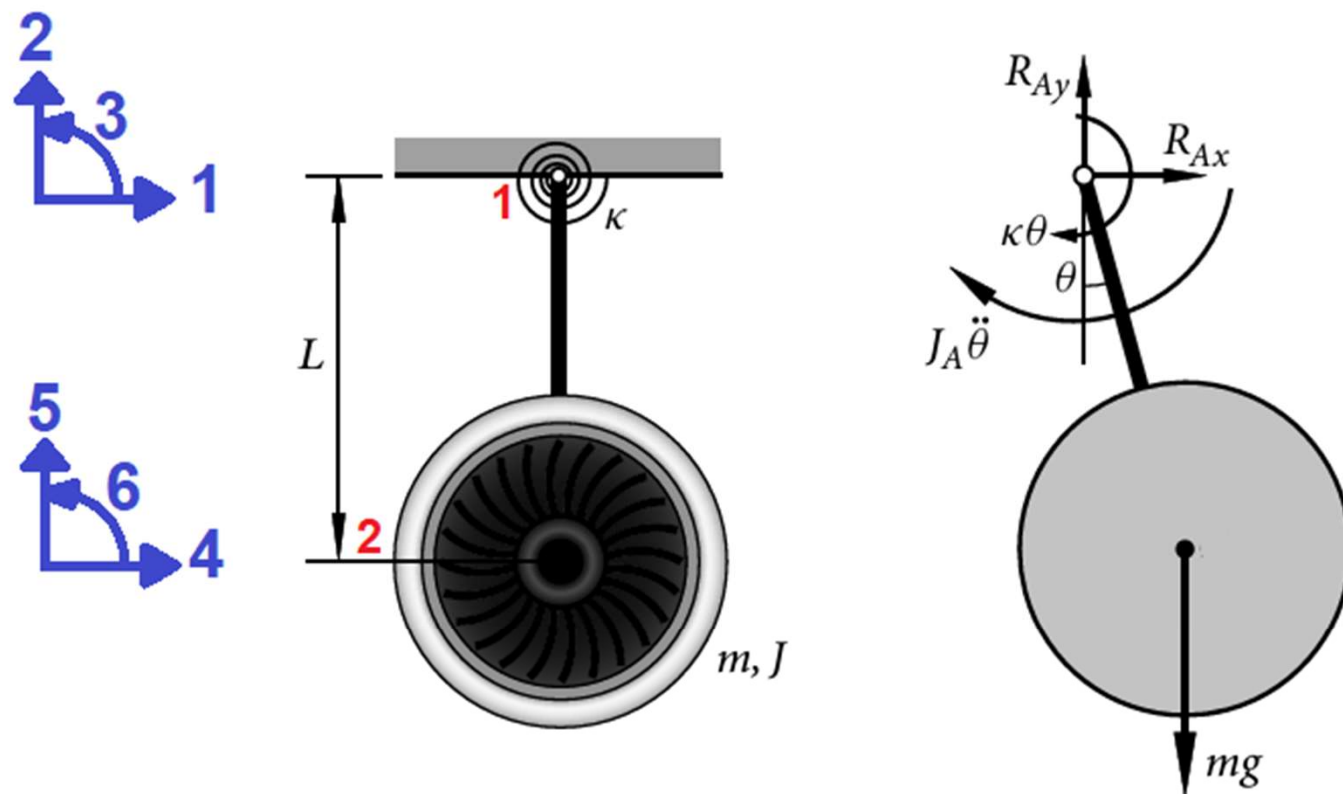


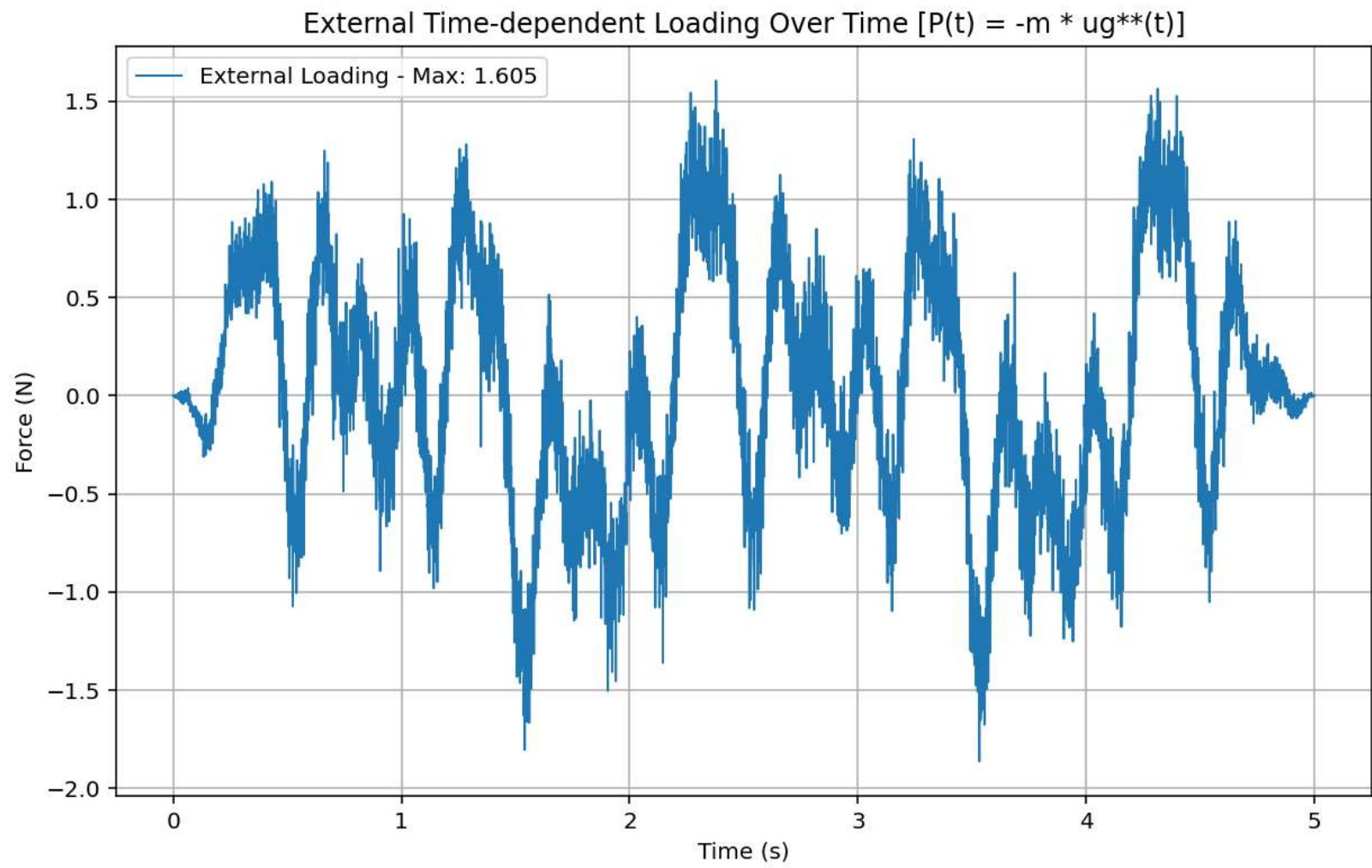
>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

# MODELING OF PENDULUM MDOF STRUCTURE USING OPENSEES

WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)



Horizontal vibration of a jet engine.



Spyder (Python 3.12)

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C:\Users\Del\Desktop\OPENSEES\_FILES\SEISMOMETER\MDF\_PENDULUM\EXAMPLE\_02\MDF\_PENDULUM\_TWO.py

MDF\_PENDULUM\_TWO.py

```
1 #####
2 # >> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<
3 # MODELING OF PENDULUM MDOF STRUCTURE USING OPENSEES
4 #  $P(t) = -m * u_g^{**}(t)$ 
5 # -----
6 # EVALUATION OF DAMPING FORCE (fD), SPRING FORCE (fS) AND INERTIA FORCE (
7 # -----
8 # THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)
9 # EMAIL: salar.d.ghashghaei@gmail.com
10 #####
11
12 Performs time-dependent loading analysis of a Multi Degree of Freedom (MDOF)
13 structure using OpenSeesPy, comparing elastic and inelastic spring behavior.
14 Key features include:
15
16 1. Implements both elastic (linear) and hysteretic (nonlinear) material models for
17 structural springs.
18 2. Supports initial conditions for displacement, velocity, and acceleration.
19 3. Uses Newmark's method for time integration with Newton-Raphson iteration.
20 4. Calculates damping ratios using logarithmic decrement from response peaks.
21 5. Generates force-displacement backbone curves for inelastic material.
22 6. Tracks and plots time-history responses (displacement, velocity, acceleration, reactions
23 7. Compares elastic vs inelastic system performance.
24 8. Includes convergence checks and analysis stability monitoring.
25 9. Outputs model data in JSON format for post-processing.
26 10. Provides theoretical validation through natural frequency calculations.
27
28 Particularly useful for earthquake engineering applications,
29 allowing evaluation of structural response under time-dependent loading
30 with different material nonlinearities and damping characteristics.
31 The hysteretic material model captures energy dissipation
32 inelastic deformation, while the elastic case serves as a reference for linear behavior.
33 -----
34 This code performs a comparative nonlinear dynamic analysis of a multi-degree-of-freedom (M
```

External Time-dependent Loading Over Time [ $P(t) = -m * u_g^{**}(t)$ ]

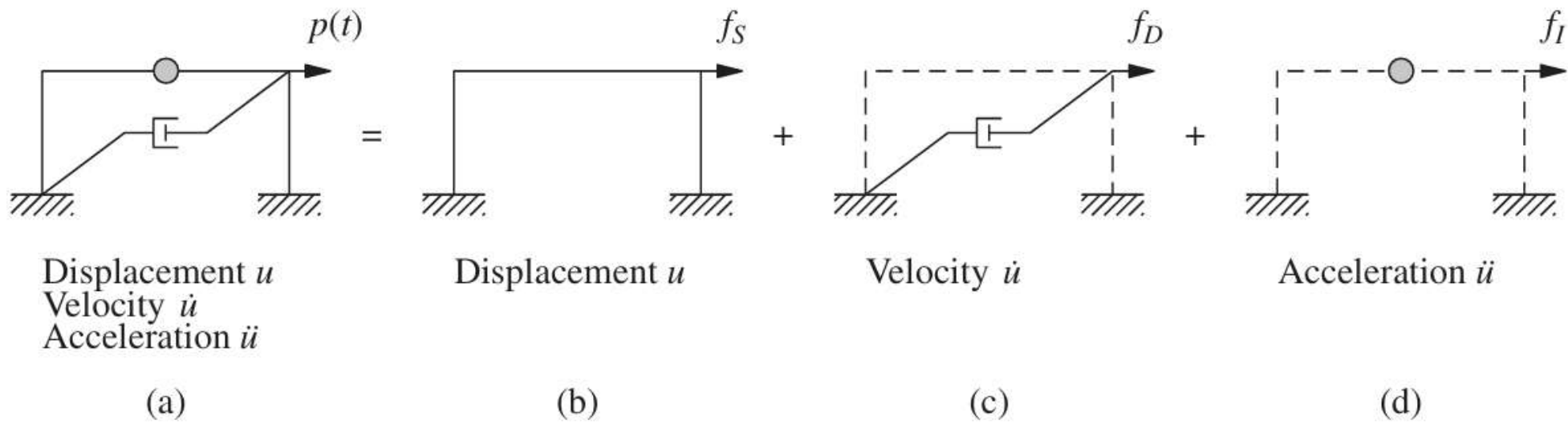
Force (N)

Time (s)

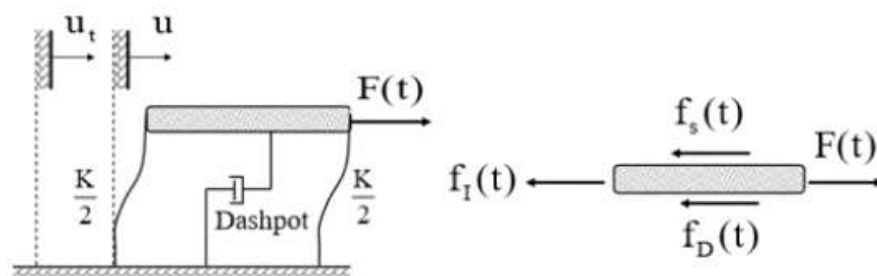
External Loading - Max: 8096.374

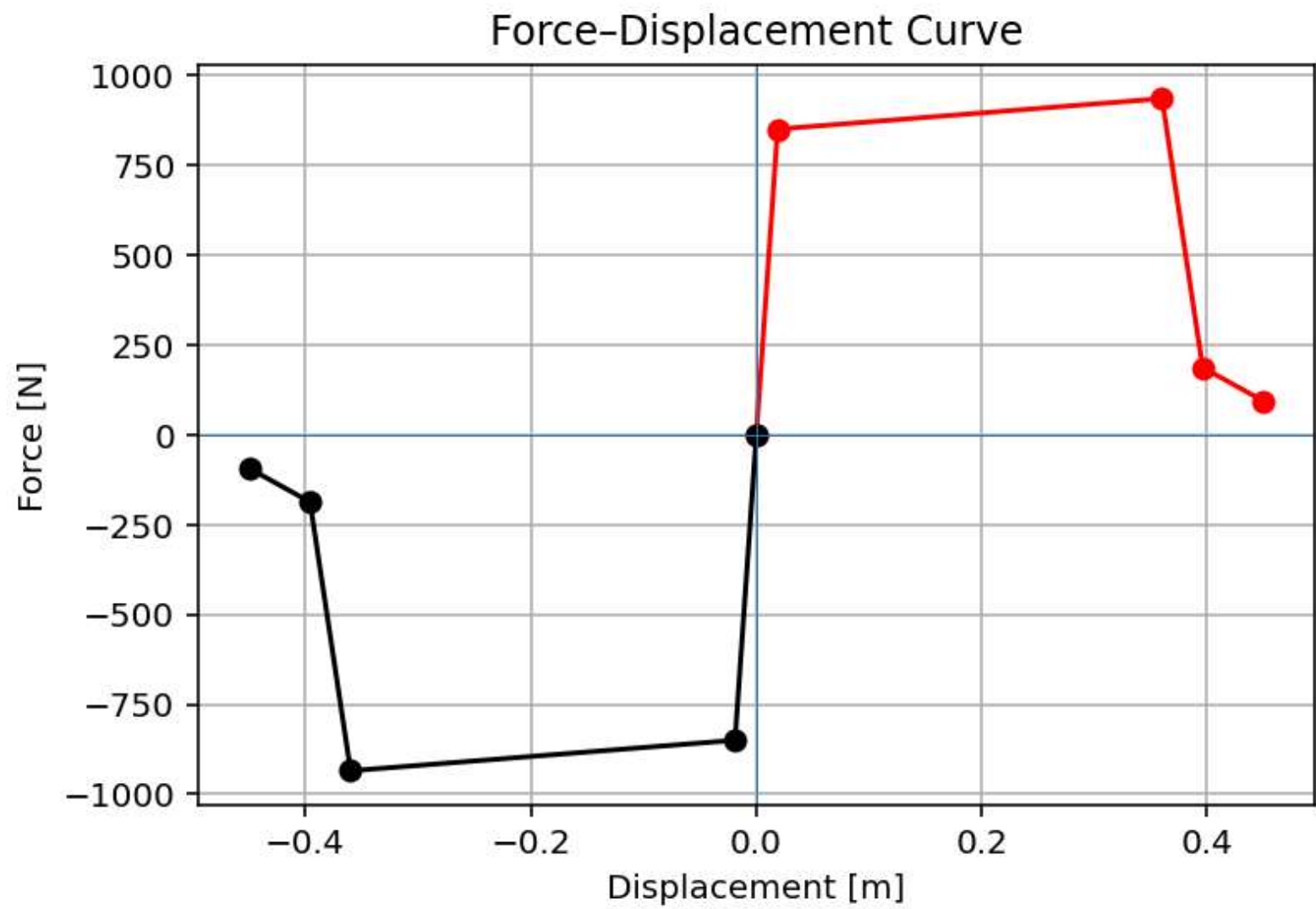
IPython Console Files Help Variable Explorer Debugger Plots History

Inline Conda: anaconda3 (Python 3.12.7) ✓ LSP: Python Line 356, Col 40 UTF-8 CRLF RW Mem 43%

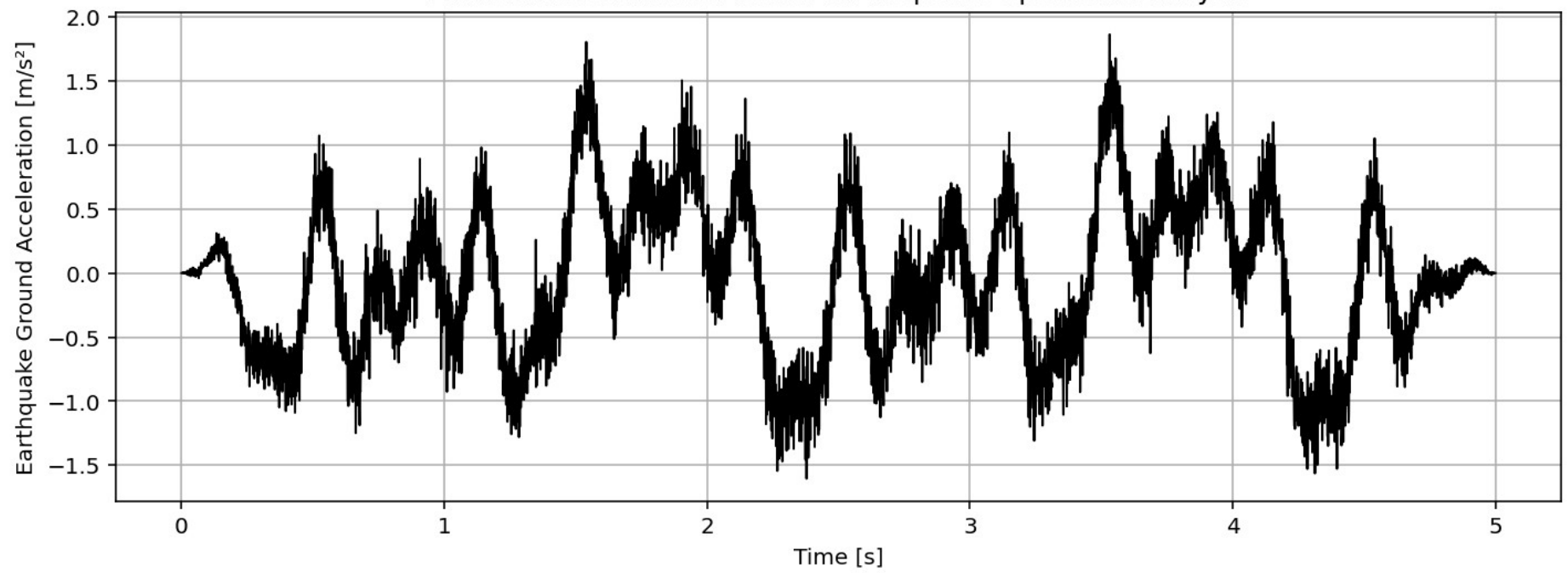


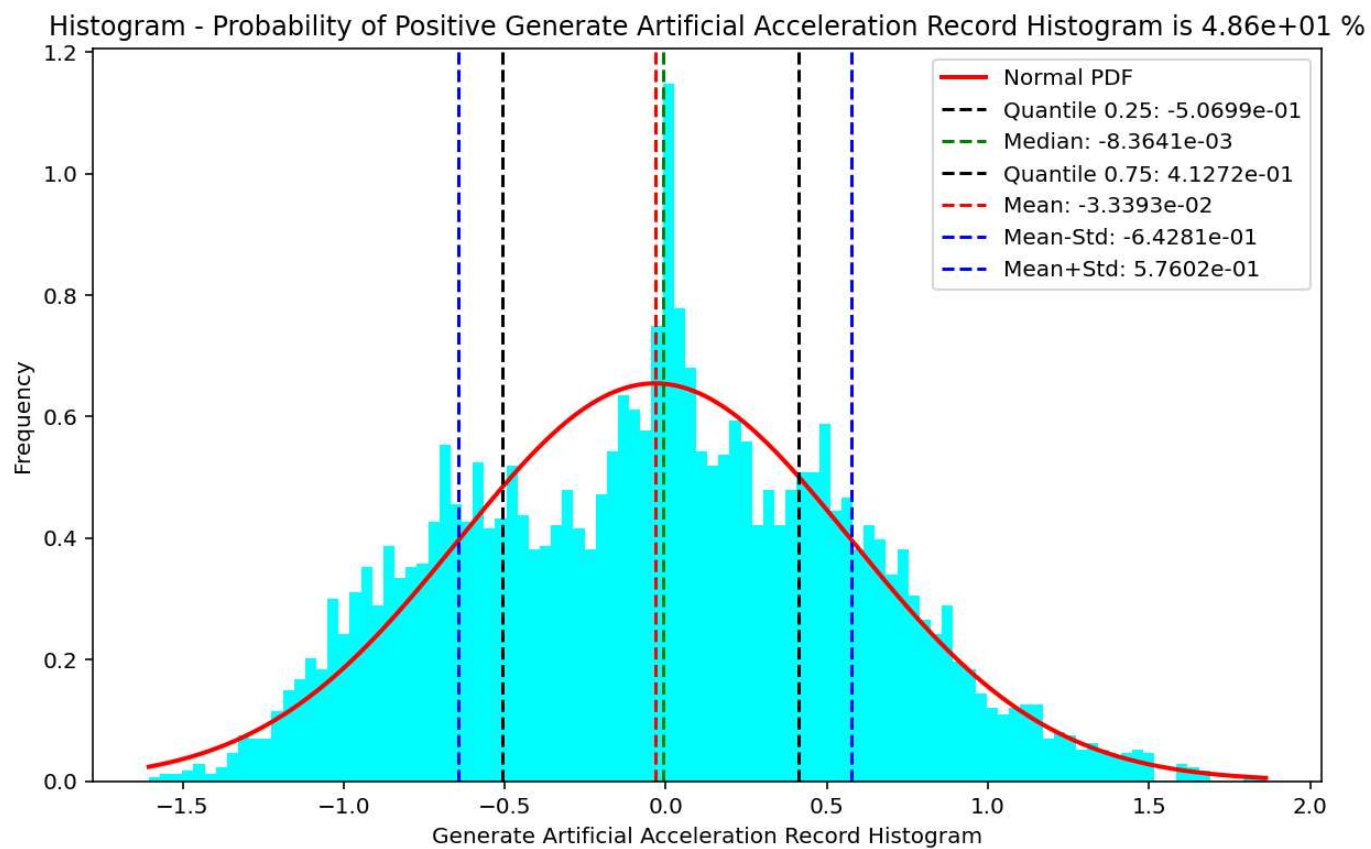
(a) System; (b) stiffness component; (c) damping component; (d) mass component.





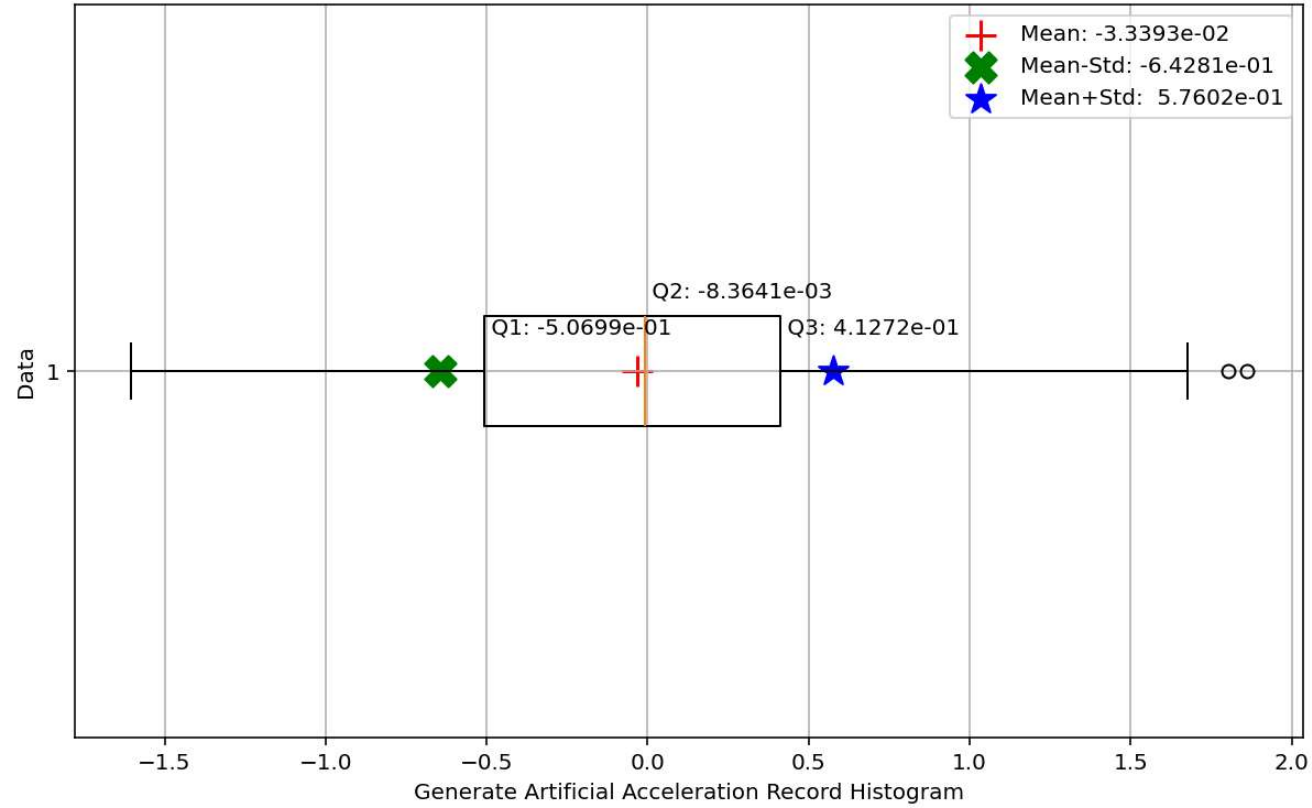
Artificial Acceleration Record for Response Spectrum Analysis



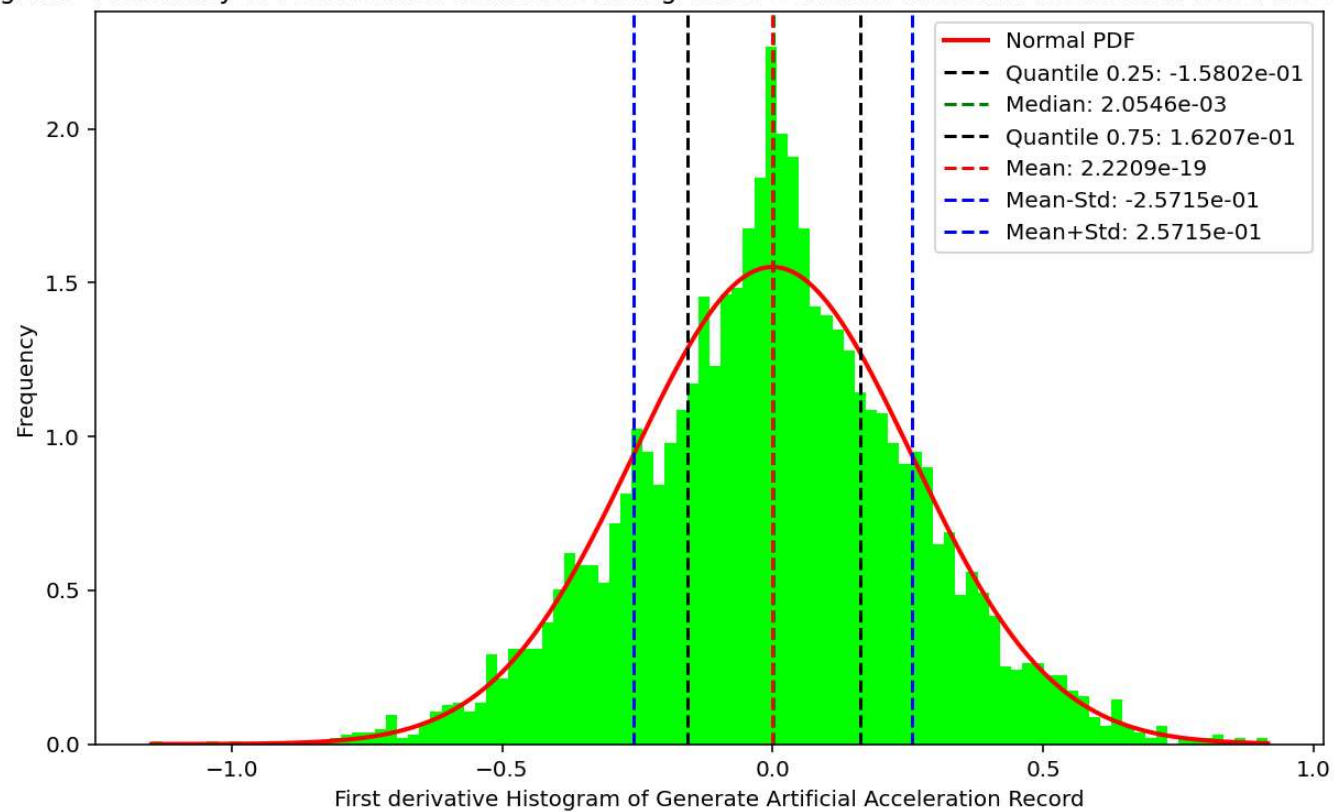


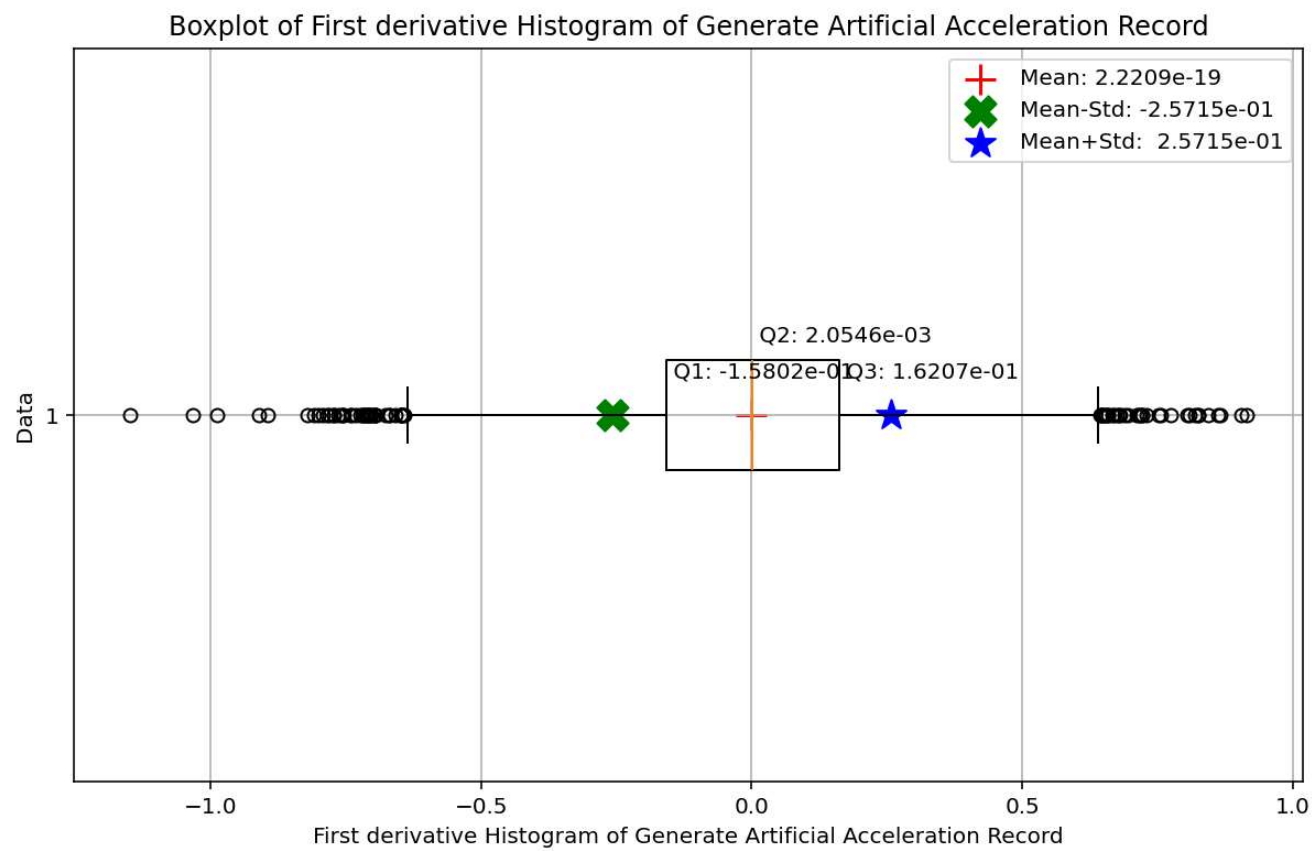


Boxplot of Generate Artificial Acceleration Record Histogram

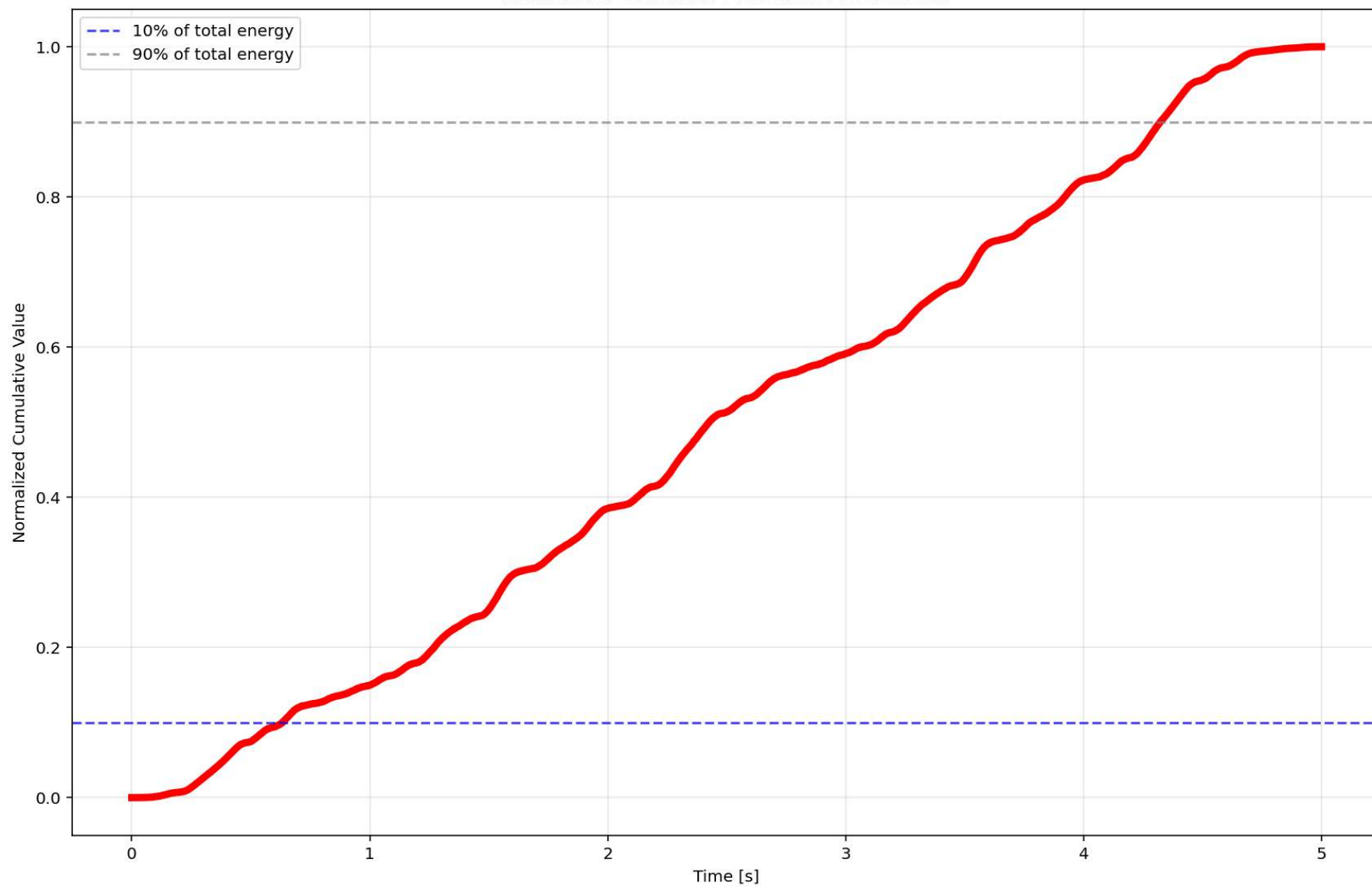


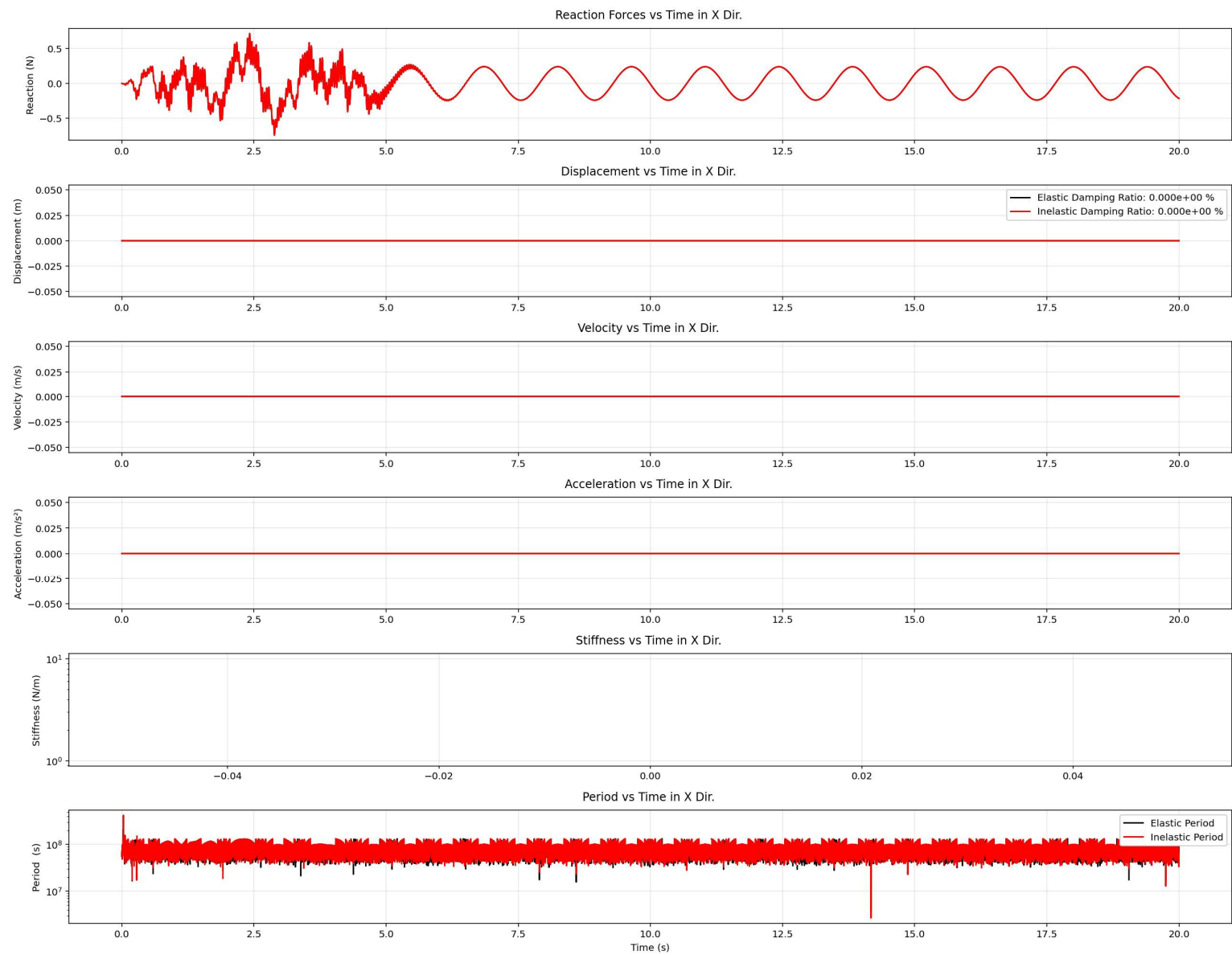
Histogram - Probability of Positive First derivative Histogram of Generate Artificial Acceleration Record is 5.07e+01 %

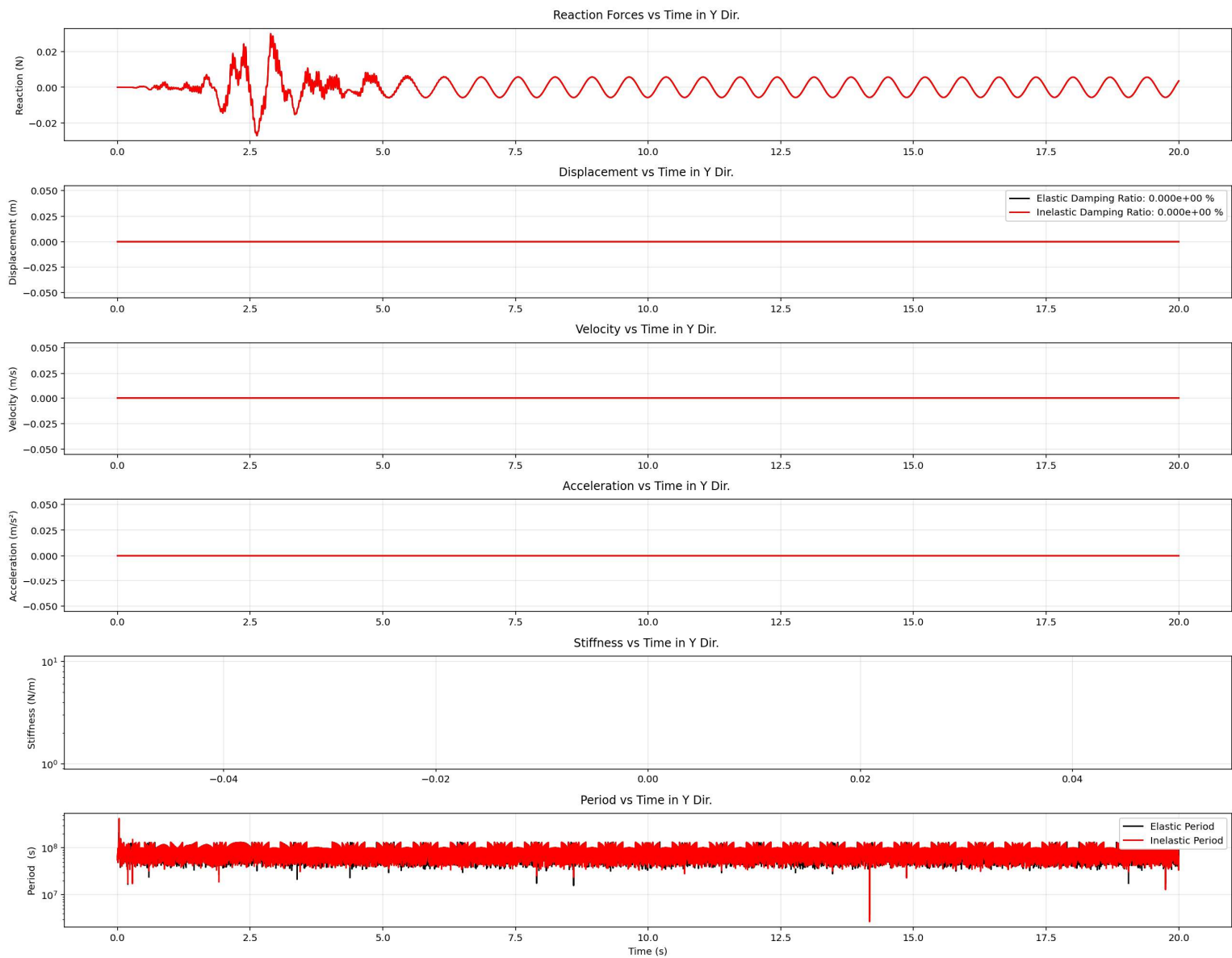


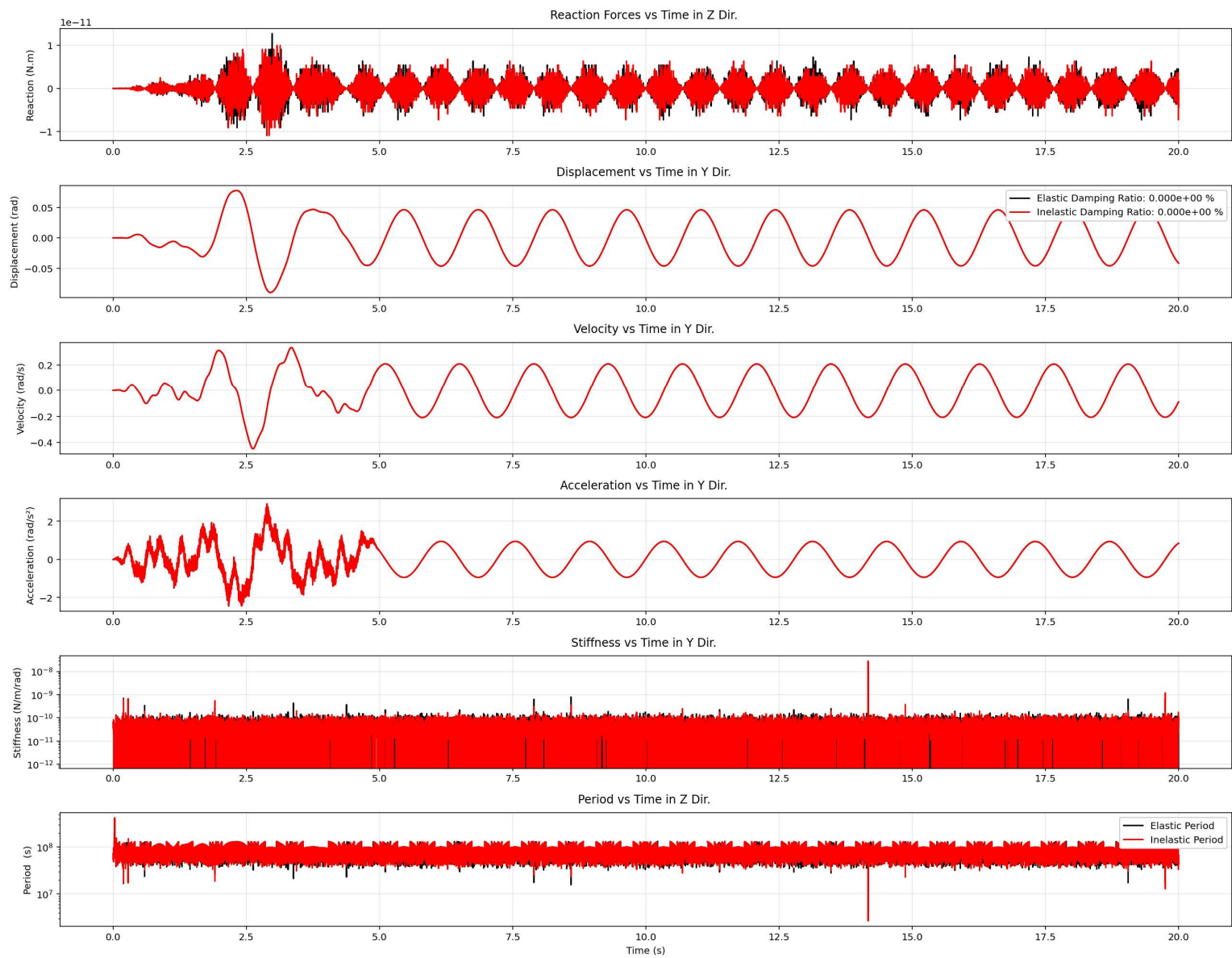


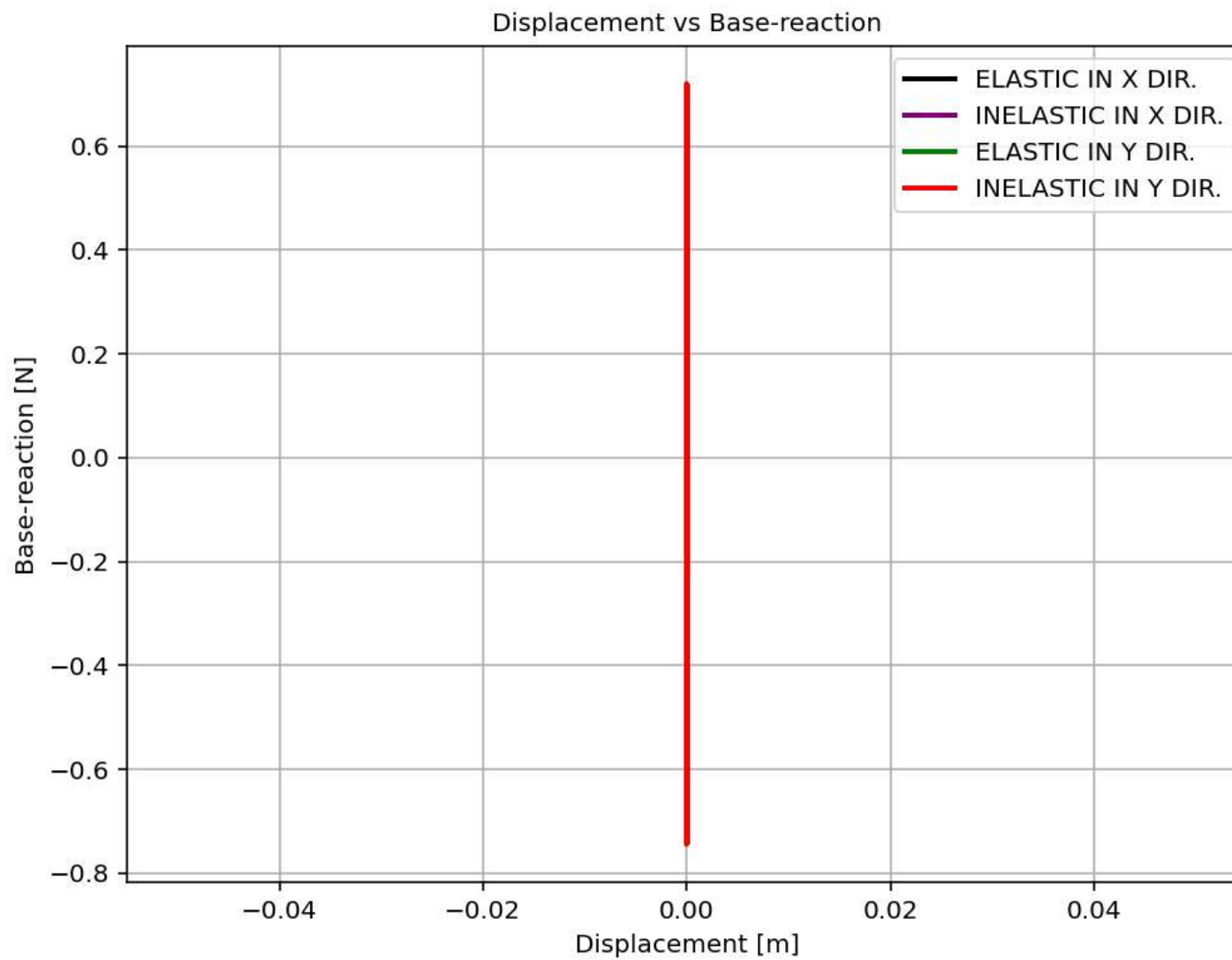
Normalized Cumulative Absolute Acceleration



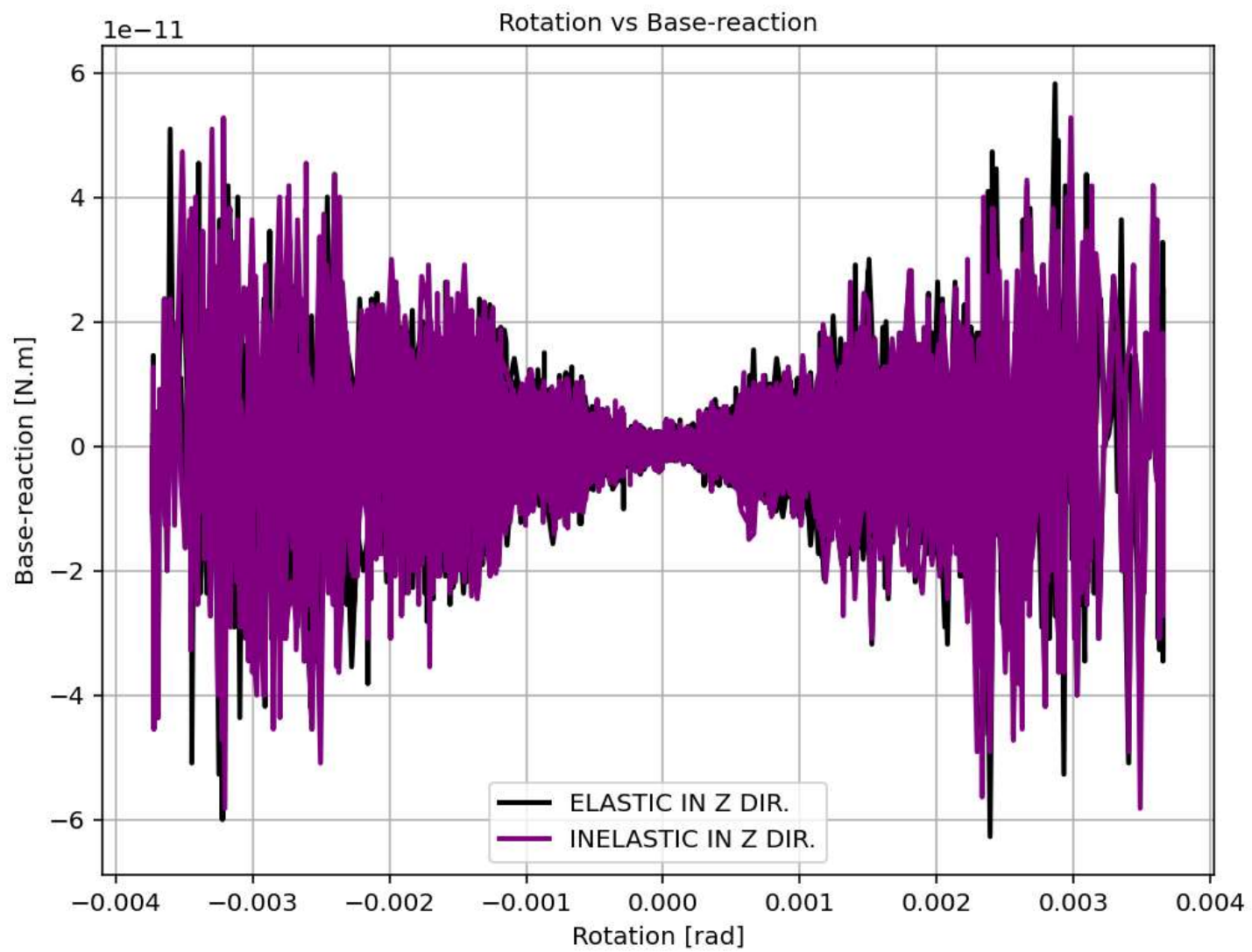


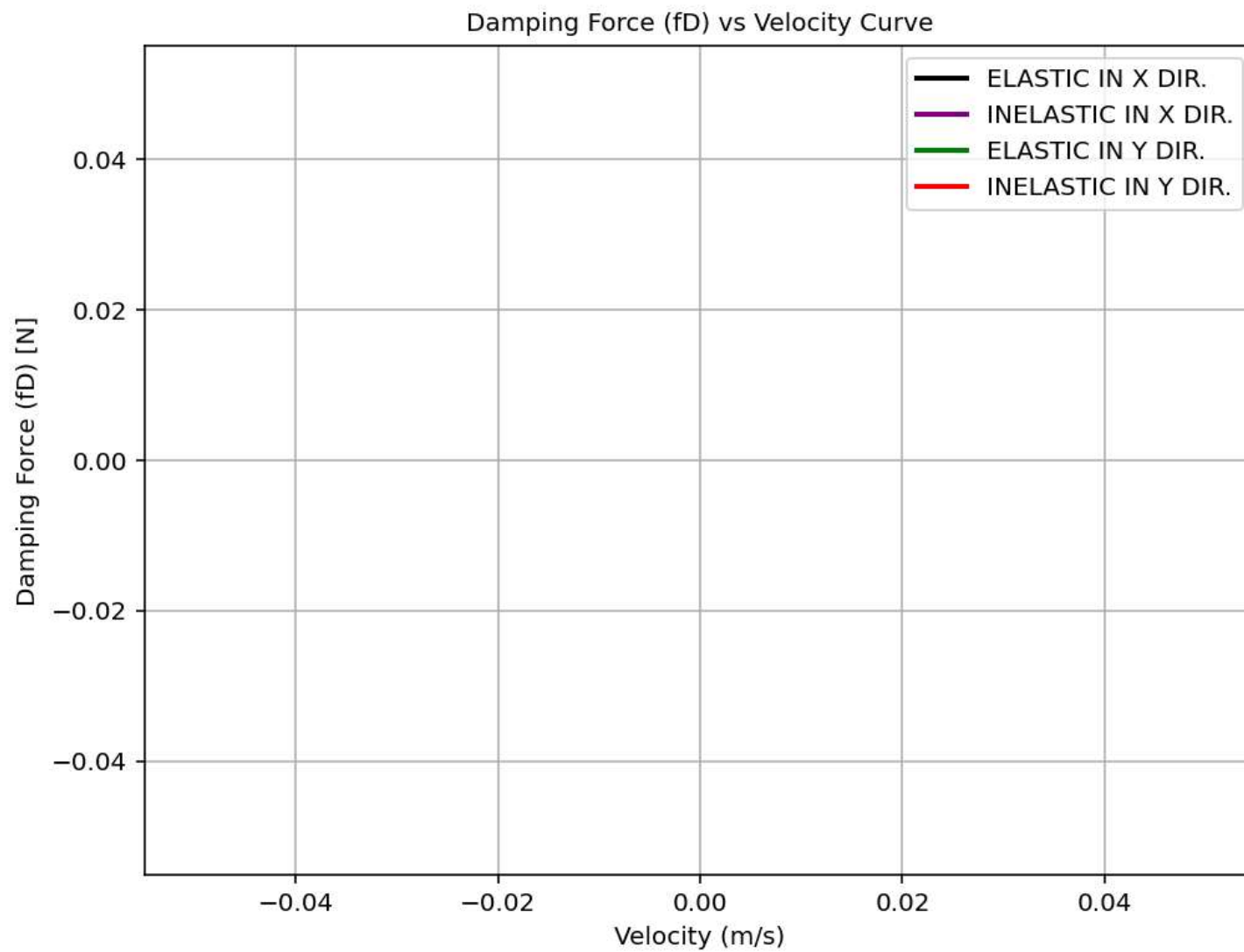


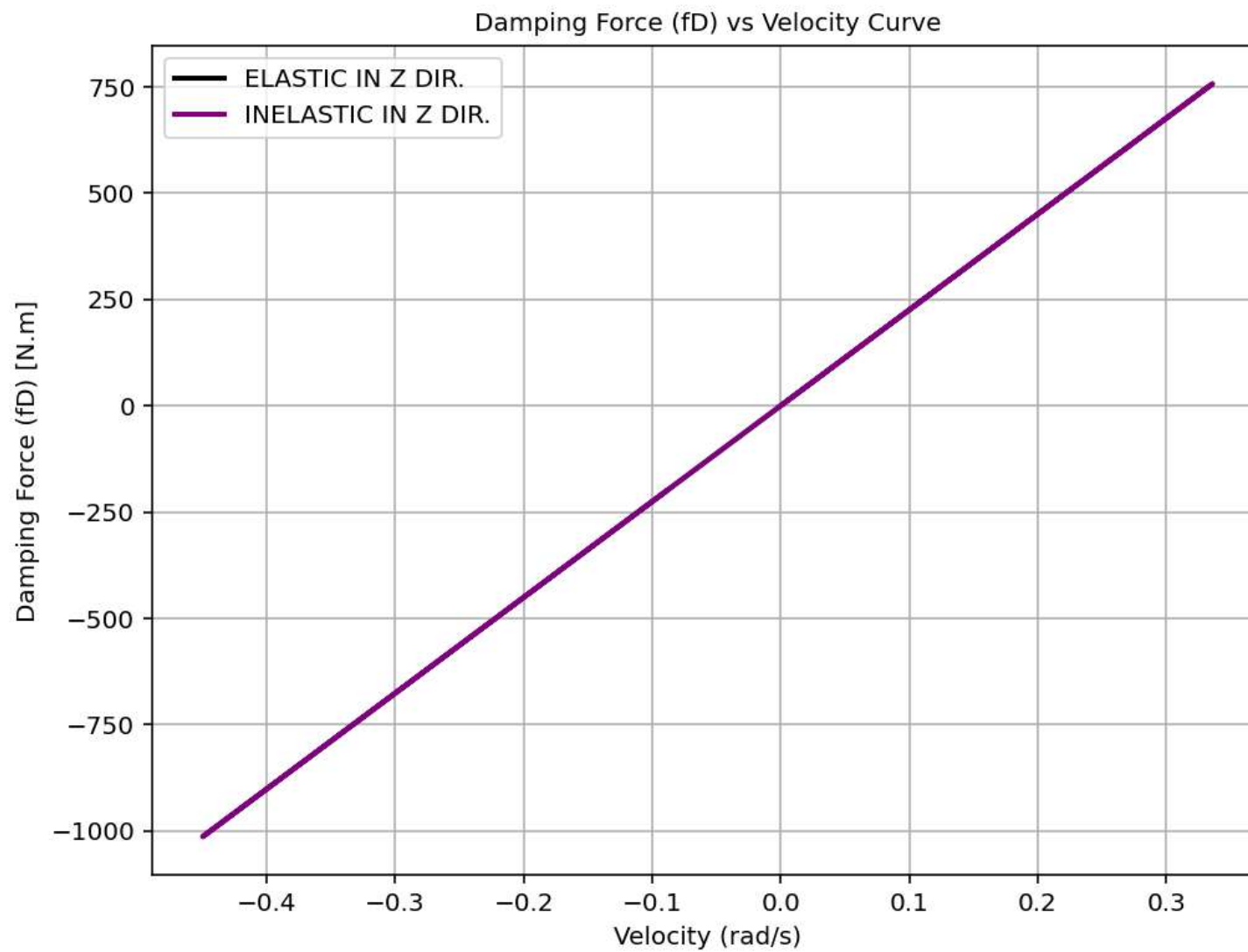


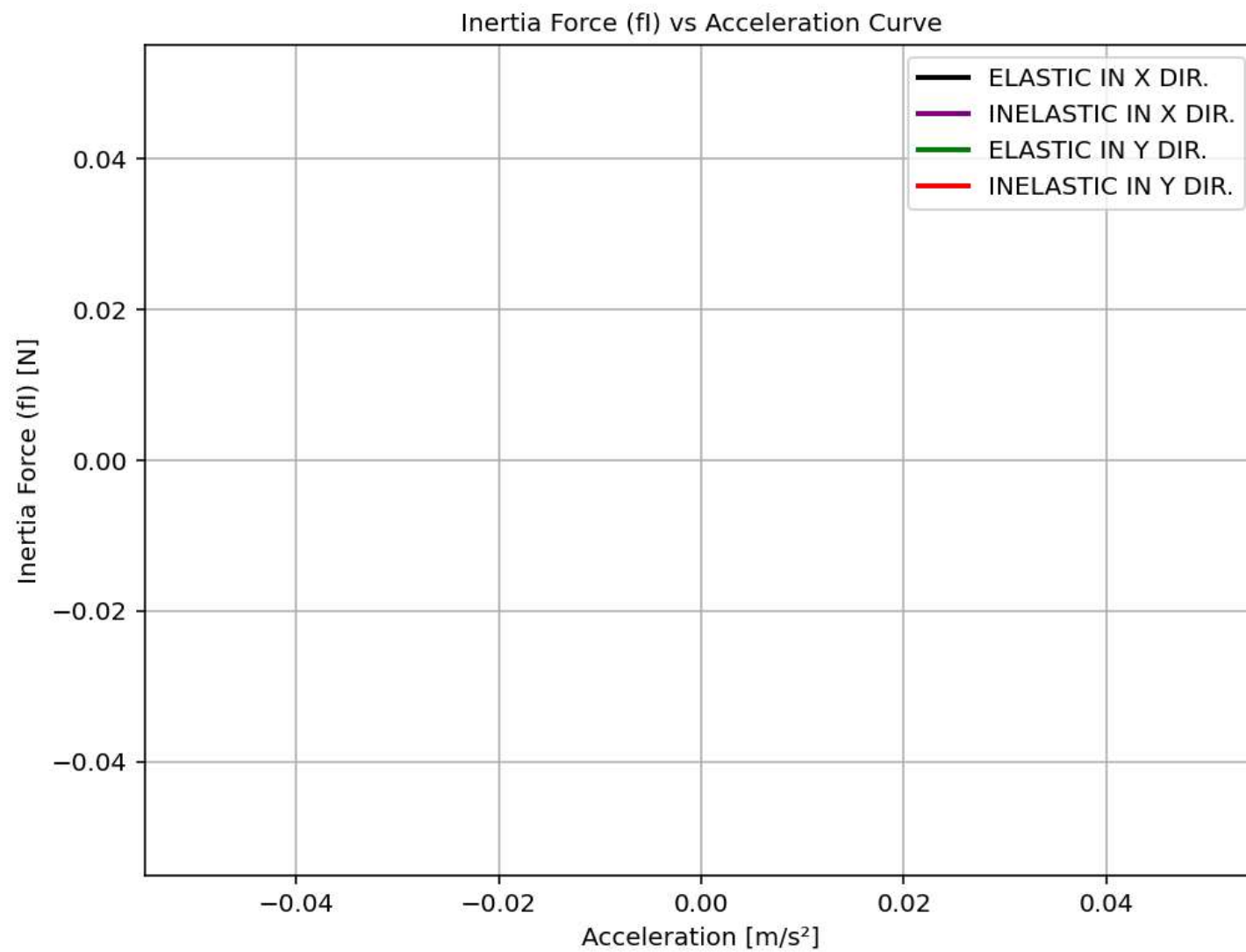


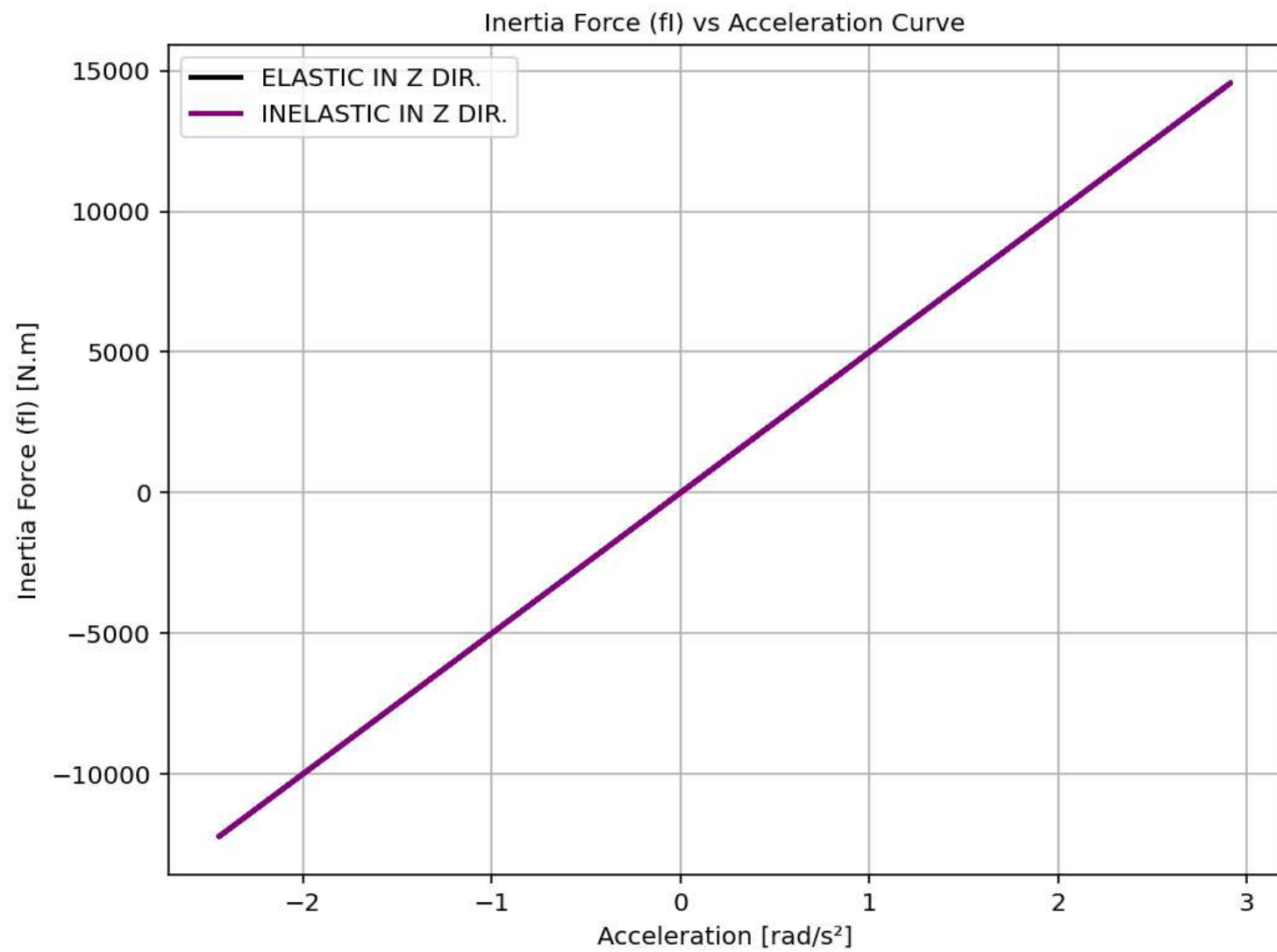


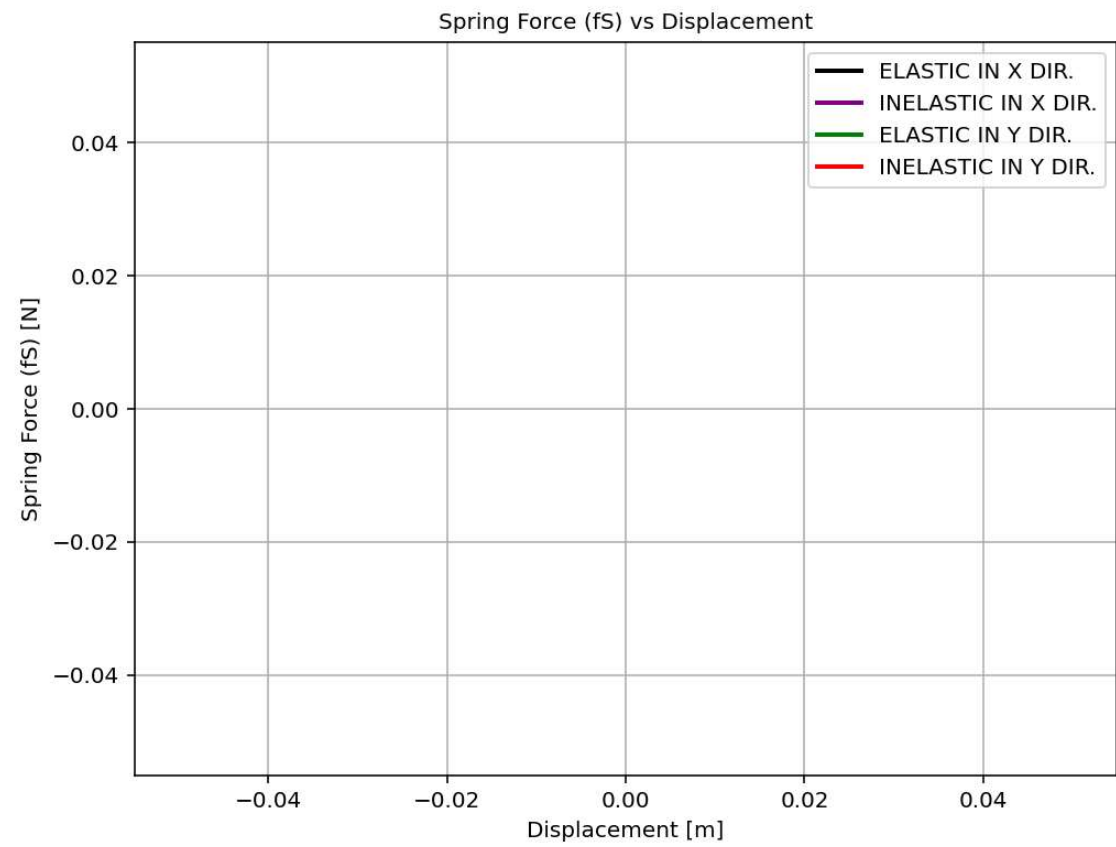


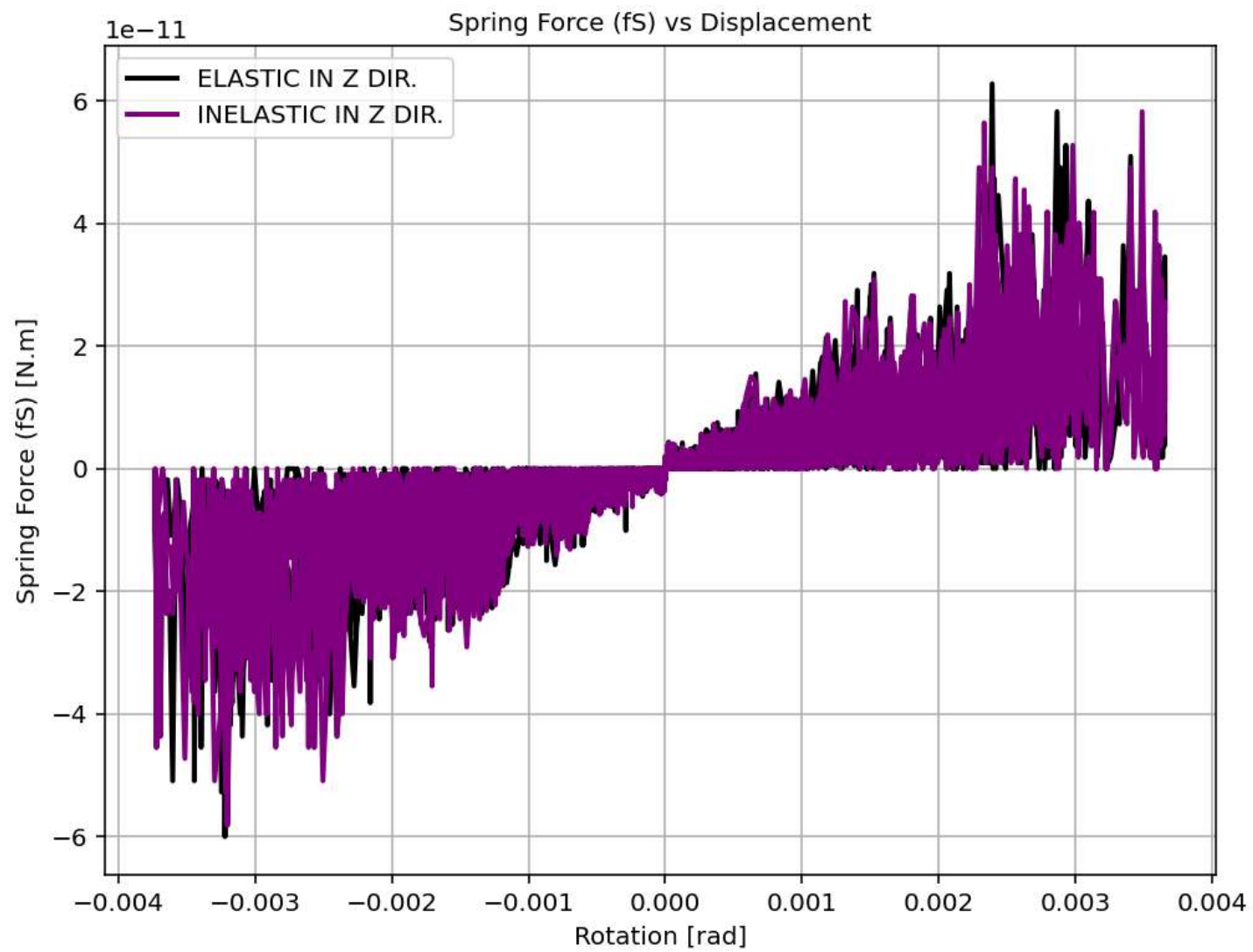












Damping Force (fD) vs Displacement Curve

