

Detected Resonant Frequencies (0-200 Hz):

80
124
146
186

Estimated Damping Ratios:

Mode near 80.00 Hz → $\zeta = 0.0375$
Mode near 124.00 Hz → $\zeta = 0.0484$
Mode near 146.00 Hz → $\zeta = 0.0274$
Mode near 186.00 Hz → $\zeta = 0.0430$

Normalized Mode Shapes (0-200 Hz):

Mode at 80.00 Hz:

X: $0.054 \angle 16.2^\circ$
Y: $0.102 \angle 64.6^\circ$
Z: $1.000 \angle -106.9^\circ$

Mode at 124.00 Hz:

X: $0.031 \angle 32.0^\circ$
Y: $0.332 \angle 41.5^\circ$
Z: $1.000 \angle -133.3^\circ$

Mode at 146.00 Hz:

X: $0.147 \angle 78.2^\circ$
Y: $1.000 \angle -77.5^\circ$
Z: $0.322 \angle -168.4^\circ$

Mode at 186.00 Hz:

X: $0.297 \angle -123.7^\circ$
Y: $0.682 \angle 77.3^\circ$
Z: $1.000 \angle 143.3^\circ$

=== Modal Parameter Summary (0-200 Hz) ===

Freq_Hz	Damping	Phi_X	Phi_Y	Phi_Z
80	0.0375	0.052312+0.015176i	0.04384+0.092235i	-0.29028-0.95694i

124	0.048387	0.02631+0.016424i	0.24906+0.22005i	-0.68624-0.72737i
146	0.027397	0.030205+0.14405i	0.2161-0.97637i	-0.31499-0.064759i
186	0.043011	-0.16505-0.24742i	0.14975+0.66553i	-0.80133+0.59822i

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124
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Estimated Damping Ratios:

0.0375
0.0484
0.0274
0.0430

=== Modal Summary (0-200 Hz) ===

Mode 1: f=80.00 Hz, Damping=0.0375, k_dyn_X=129945915.77 N/m, k_dyn_Y=69307613.52 N/m, k_dyn_Z=7077965.56 N/m

Mode Shape (X,Y,Z): 0.054∠16.2°, 0.102∠64.6°, 1.000∠-106.9°

Mode 2: f=124.00 Hz, Damping=0.0484, k_dyn_X=266055536.25 N/m, k_dyn_Y=24828917.98 N/m, k_dyn_Z=8251866.38 N/m

Mode Shape (X,Y,Z): 0.031∠32.0°, 0.332∠41.5°, 1.000∠-133.3°

Mode 3: f=146.00 Hz, Damping=0.0274, k_dyn_X=98546630.80 N/m, k_dyn_Y=14504707.36 N/m, k_dyn_Z=45105063.76 N/m

Mode Shape (X,Y,Z): 0.147∠78.2°, 1.000∠-77.5°, 0.322∠-168.4°

Mode 4: f=186.00 Hz, Damping=0.0430, k_dyn_X=253150497.66 N/m, k_dyn_Y=110372625.11 N/m, k_dyn_Z=75292444.87 N/m

Mode Shape (X,Y,Z): 0.297∠-123.7°, 0.682∠77.3°, 1.000∠143.3°