Computing Eigenvalue & Eigenvector Design Derivatives

- Design sensitivities (or derivatives) are key enablers to simulation-based optimal design.
- Eigenvalue and Eigenvector derivatives are needed when natural frequencies and mode shapes define critical design constraints.

\[
[K - \lambda M] \Phi = 0
\]

\[
\frac{d\lambda_i}{db_j} = \frac{1}{C_i} \Phi_i \cdot \left[ \frac{\partial K}{\partial b_j} - \lambda_i \frac{\partial M}{\partial b_j} \right] \Phi_i
\]

\[
[K - \lambda_i M] \frac{d\Phi_i}{db_j} = - \left[ \frac{\partial K}{\partial b_j} - \frac{d\lambda_i}{db_j} M - \lambda_i \frac{\partial M}{\partial b_j} \right] \Phi_i
\]

- Generalized approach for eigenvector derivatives is developed here that systematically incorporates effect of mode normalization.

mode 1

mass normalized

max component normalized

magnitude normalized