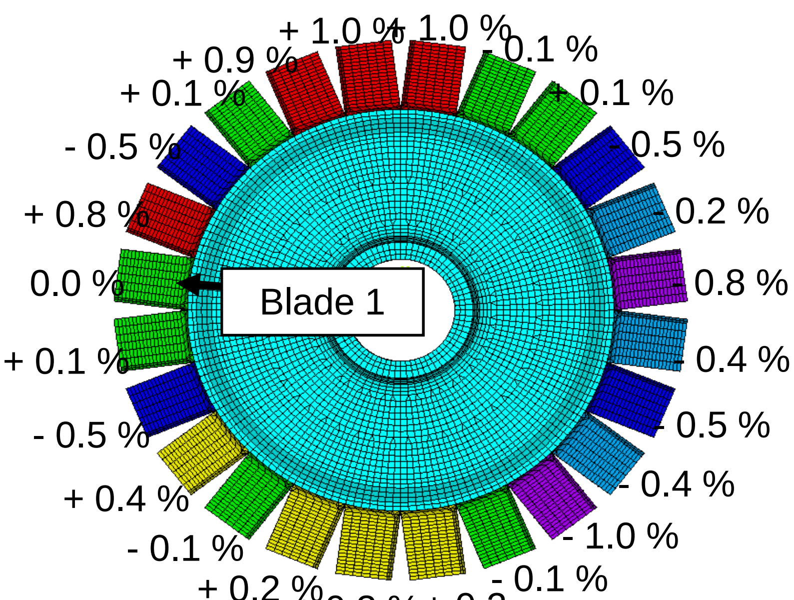
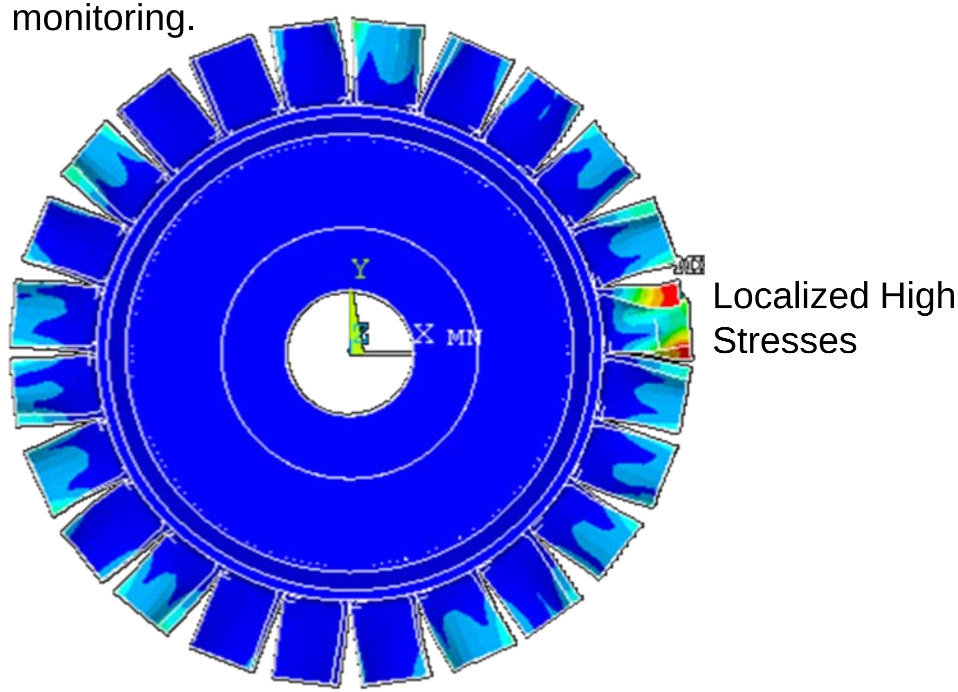
Modeling and Identification of Mistuning in Bladed Disks

Bladed disks such as those found in jet engines are cyclically symmetric structures. However, slight deviations from this symmetry caused by manufacturing, wear, etc. can result in a highly non-symmetric distribution of stresses during the vibration of such systems. Such a phenomenon is also known as vibration localization and leads to extremely high stresses, causing high cycle fatigue and premature failure of the structure. These deviations, known as mistuning, can be identified using reduced-order modeling techniques along with experimental response data. With the mistuning known, more accurate models can be constructed to predict the dynamics of the system (e.g. stresses and aeroelastic responses).

We develop mistuning identification technology through an integrated computational and experimental research. We create novel methodologies for solving inverse problems involving complex systems, with a focus on cyclic structures. We also develop models which account for fluid-structure interactions which affect localization and high-cycle fatigue. We investigate complex, multi-stage and aeroelastic systems, and exploit localization for damage detection to enable advanced structural health monitoring.



Blade Mistuning Pattern



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