Structural Dynamics and Acoustic Systems Laboratory
University of Massachusetts Lowell
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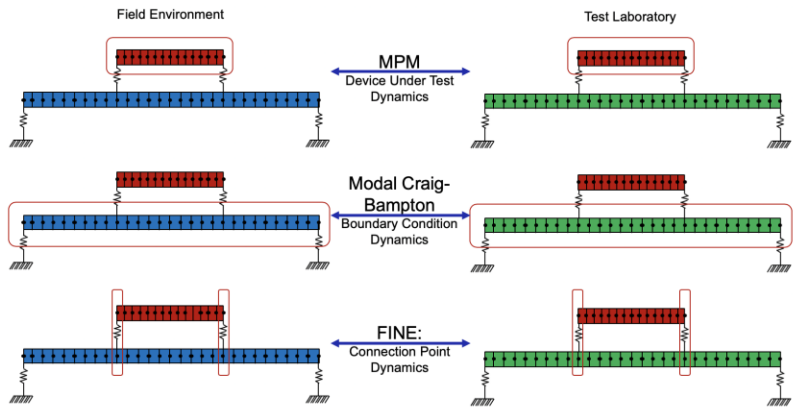
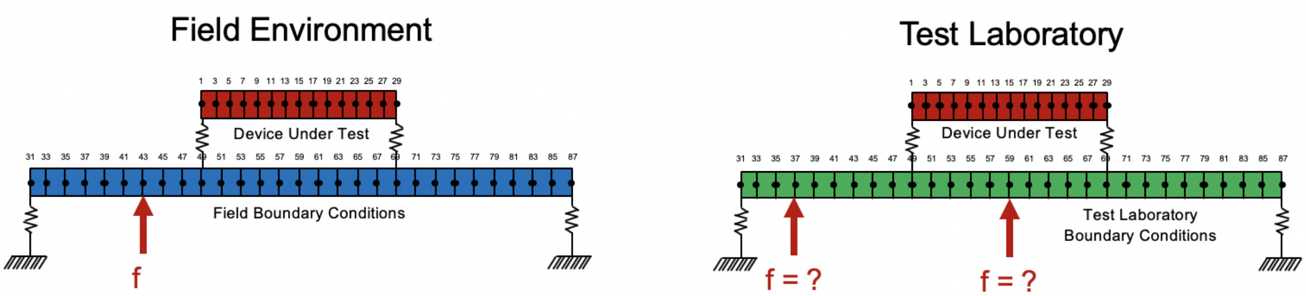
PHD DISSERTATION – BRANDON ZWINK

Boundary Condition Compensation



Classical laboratory vibration testing involves producing a specified dynamic system response in the laboratory based on the field environment of the system. However, achieving field level responses in the laboratory typically involves modifying the boundary conditions of the system either to hold the part or to attach an excitation source. The vibration fixture is typically assumed to be rigid in the frequency range of excitation even though this is seldom a valid assumption. Multiple methods have been introduced to derive excitations that account for the flexibility in vibration test fixturing. These methods include a method based on frequency response function measurements (FIxture-NEutralization - FINE), component mode synthesis (Modal Craig-Bampton), and a mode shape transformation matrix (Modal Projection Matching - MPM). This thesis compares the theory for these three methods and applies each of them to various test fixture configurations in a two-beam model.



A new method to compute optimized forces to match target modal responses is also introduced. The optimized force is derived from an equation that describes the relationship between modal displacement and physical force (as opposed to a traditional frequency response function that describes the relationship between physical force and physical displacement). This new method allows the dynamics to be described and investigated in a more complete and yet condensed form than traditional methods.

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