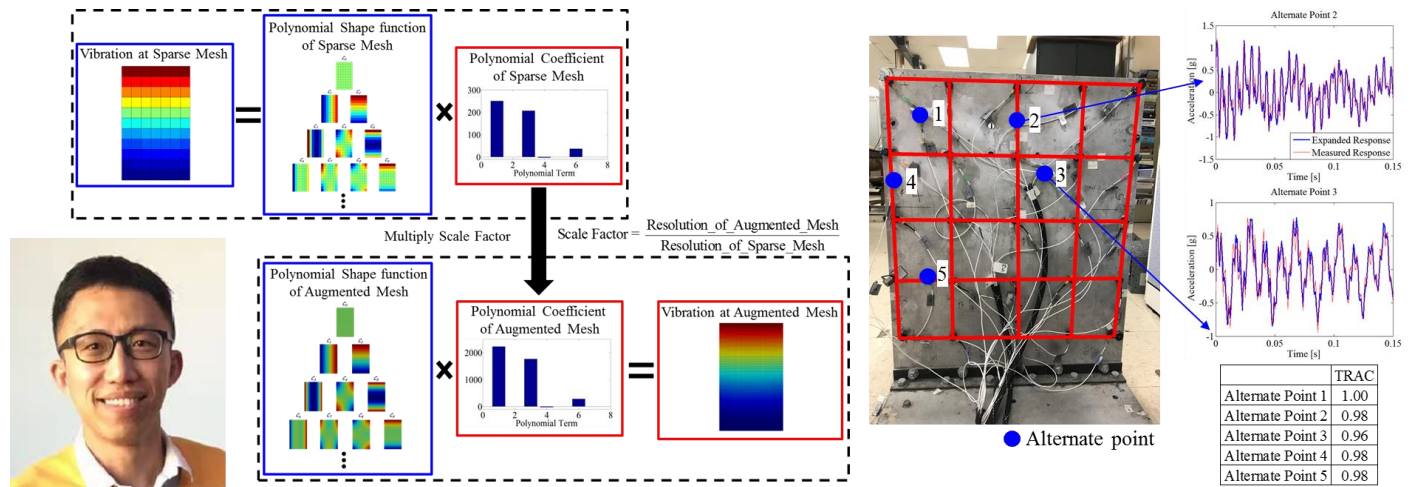


PHD DISSERTATION – YUANCHANG CHEN

A Non-Model Based Expansion Method for Predicting the Vibration at Augmented Set of Points and Data Quality Validation Using Chebyshev Polynomial Shape Function



A non-model based expansion technique is proposed to expand the vibration characteristics at a sparse set of points to a much larger set of points without the use of a finite element model. Shape functions based on orthogonal polynomials can be used to decompose the deformation of vibrating structures into the summation of a set of shape functions with corresponding weighting coefficients. To obtain the vibration characteristics at an augmented set of points, measurements at a sparse set of points can be related to a set of shape functions which have the same mesh resolution as the sparse configuration. The vibration characteristics at an augmented set of points can then be reconstructed from the shape functions of the high resolution and scaled shape function weighting coefficients of the sparse configuration. Only a sparse set of measurements, geometry and coordinates of measured points are needed. This polynomial expansion approach can also be used as a data quality validation tool to identify the poorly measured data. An analytical plate, a Base-Upright (BU) structure, a dryer cabinet base panel, and a large-scale robot roadway structure are used as samples to study the application of the proposed method. Both analysis and experiment are used to prove the concept.