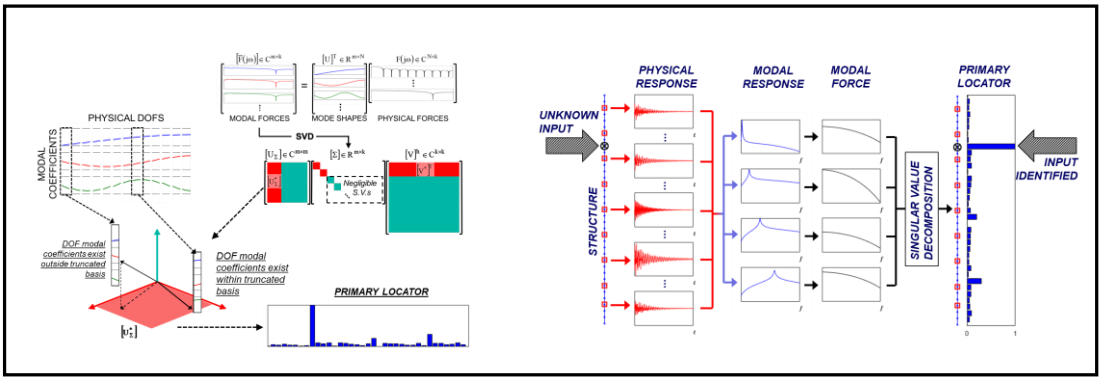
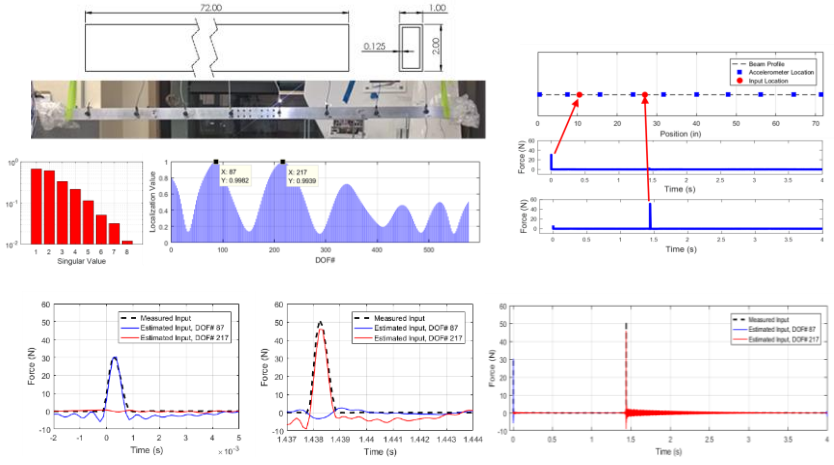
PHD DISSERTATION – PATRICK LOGAN

Force Reconstruction Beyond Measured Points





A methodology for the reconstruction of dynamic loads from vibration response data is developed which employs a well-correlated finite element model to permit load identification at locations where no response measurements are available; this is extended from a force reconstruction approach based upon modal filtering. The methodology is then applied to a structure where some unmodeled physical perturbation exists to permit identification of the modification. Force reconstruction is approached from a modal perspective, where modal responses are estimated from physical response data, followed by independent reconstruction of modal forces for each modal oscillator. Modal force estimates are analyzed in aggregate via singular value decomposition to permit identification of input locations which are compatible with the estimated modal force patterns. Modal forces are then returned to the physical domain via transformation by modal matrices. Where a change in the physical system causes observable changes in the dynamic behavior of the system such that the response is inconsistent with that of the unmodified system, application of the force reconstruction methodology permits identification of the modification as an equivalent dynamic load. The proposed methodology is developed using linear system theory but is extended to systems which exhibit discrete nonlinearities in the form of contact.

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