**DEVELOPMENT OF DYNAMIC RESPONSE MODELING TECHNIQUES FOR LINEAR MODAL COMPONENTS INTERCONNECTED WITH NON-LINEAR CONNECTION ELEMENTS**

*Timothy Marnane, Louis Thibault, Christopher Niezrecki, Peter Avitabile*  
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### THEOREY

- Develop physical reduced model database for potential system contact states
- Develop direct integration physically reduced equations of motion

### ALGORITHM

1. **DISCRETIZATION**
   - FE MODEL
2. **LOADS & BC’S**
3. **NONLINEAR ELEMENT MODELING**
4. **SOLVE DYNAMIC TIME RESPONSE**

### RESULTS

- **Nonlinear Elements Approximated As Piecewise Linear**
- **Efficient Modeling Drastically Reduces Computation Time**

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### RESULTS

- **Analytical**
  - Multiple Beam Multiple Contact
  - Single Beam-Single Contact
- **Experimental**
  - Single Beam-Single Impact

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