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Optimizing Steel Railway Truss Bridge Health Monitoring

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### Objectives

- Initial field testing plan:
  - Initial field testing instrumentation planning
  - Initial field testing, model calibration
  - Analysis based health monitoring plans
  - Verify analysis based health monitoring plans via testing

### Model Calibration

- **Model:**
  - 3D frame model PLUS Rails/ties
  - Geometric offsets, connections

### Analysis Based Health Monitoring Plan

- **Sensitivity Analyses:**
  - Modified models - mimic reported condition - 20 models
  - E.G. – cracked connection

- **Proposed health monitoring plan:**
  - ~2200 permutations
  - 3 proposed plans

### Bridge Under Study

- **Multi-Span Steel Through-Truss**
  - Double-Track
  - Riveted Construction
  - Eyebars

- **Condition Foci:**
  - Stringer-to-floor beam connections
  - Stringer and truss bottom laterals
  - Eyebars
  - Bearings

### Problems - Steel Railway Trusses

- **Aging**
- **Large system – bridge AND railway**
- **Labor intensive condition eval**
- **Reported conditions:**
  - Stringer-to-floor beam connections [Haghani 2012]
  - Stringer flange clip angle cracks [Haghani 2012]
  - Unequal eyebars stress distribution [DelGrego 2008]
  - Displaced eybar pins [DelGrego 2008]

### Initial Field Testing

- **Stringer-to-floor beam connection**
- **Stringer flange clip Angle**

### Problems – Condition Evaluation

- **Visual inspection:**
  - Prescribed frequency
  - **Costly**
  - Subjected to human interpretation

- **Sensors:**
  - Focused on a single bridge
  - Extensive array
  - **Costly**

### Conclusions, Future Work

- Validated model - published test results
- Field tests/model calibration – SHM planning
- Proposed SHM plans
- Validated SHM plans - field monitoring

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**Stringer mid-span bottom stresses**

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<th>5.22</th>
<th>5.70</th>
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<td>Defected Stress reduced</td>
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**Stringer #1 end-span bottom stresses**

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**Samples**

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**Final steps**

- Analysis based health monitoring plans
- Verify analysis based health monitoring plans via testing

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**Initial steps**

- Initial field testing instrumentation planning
- Initial field testing, model calibration
- Analysis based health monitoring plans

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**Assumed conditions**

- Stringer #1 end-span bottom stresses
- Field Results (B4539) vs Model Results (B4539) vs Defected Stress reduced