Introduction

- Bridges are critical in transportation infrastructure
- Endure various loading conditions and environmental effects
- As of 2010, of the near 600,000 US highway bridges, nearly 11.5% were structurally deficient
- There is a need to continuously monitor these structures using non-destructive processes
- A decision supporting system can be incorporated to ensure bridges receive timely maintenance and repair
Current Approach for Condition Assessment

- At least every two years, FHWA administers bridge inspections according to National Bridge Inspection Standards
- Visual inspections are a most common practice
- Conventional non-destructive evaluation techniques are implemented; can be costly and require a skilled user
- Address advancing technologies, in particular using commercially available remote sensing techniques in bridge inspections

Critical Tasks

- **Task A - Condition Assessment**
  - Raw GPR Output
  - Post-processed Output

- **Task B - Commercial Sensor Evaluation**
  - Raw GPR Output
  - Post-processed Output

- **Task C - Decision Support System**
  - Task D - Field Demonstration

- **Task E - Assessment**

Top Priorities / Challenges

<table>
<thead>
<tr>
<th>Location</th>
<th>“Top 10” Priorities/Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck Surface</td>
<td>Map cracking, Scaling, Spalling, Delaminations (thru surface cracks), Expansion Joint External Issues</td>
</tr>
<tr>
<td>Deck Subsurface</td>
<td>Scaling, Spalling, Delaminations , Expansion Joint Internal Issues, Corrosion, Chloride Ingress</td>
</tr>
<tr>
<td>Girder Surface</td>
<td>Structural Steel and Structural Concrete Cracking, Paint Condition, Steel or Concrete Section Loss</td>
</tr>
<tr>
<td>Girder Subsurface</td>
<td>Structural Concrete Cracking, Concrete Section Loss, Chloride Ingress, Prestress Strand Breakage</td>
</tr>
<tr>
<td>Global Metric</td>
<td>Bridge Length, Settlement, Transverse Movement, Vibration, Surface Roughness</td>
</tr>
</tbody>
</table>
Commercial Sensor Evaluation Report

Evaluated twelve RS technologies for Bridge Condition Assessment

Performance criteria:
- Commercial availability
- Sensitivity of measurement: resolution
- Cost: capital, operational
- Ease of pre-collection prep: structure, equip
- Ease of data collection and operation
- Complexity of analysis
- Stand-off distance rating
- Traffic Disruption

Written for consideration of bridge engineers

CSE Report: Promising Technologies

Further investigated technologies:
- Radar including SAR and InSAR
- Street-view Style Photography
- 3-D Optics including Photogrammetry
- Satellite Imagery and Aerial Photography
- Thermal Infrared (IR) [featured technology]
- Digital Image Correlation [featured technology]

Thermal IR

**Definition:** Measuring the radiant temperature of the concrete deck by thermal infrared camera (anomalies interrupt the heat transfer through the concrete).

**Proposed Application:** Locating delaminations and other subsurface defects.

Digital Image Correlation

**Definition:** Technique consisting of correlating pixels on optical images to determine variations

**Proposed Application:** Global response (movement, settlement, vibration); 3D models
Further investigated remote sensing technologies shows great feasibility for bridge condition assessment

- Continued laboratory tests and field demonstrations applications for technologies
- An integrated decision support system will be analyze to complement bridge inspection practice
- A comprehensive project review will be completed for total project analysis

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  – Michigan Tech Transportation Institute
  – Michigan Tech Research Institute
  – Center for Automotive Research

- Technical Advisory Council

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Thank You!

Questions?...

For more information on this project:
www.mtti.mtu.edu/bridgecondition/