Machine Vision Inspection of Railroad Track: Turnouts

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Presentation Outline

- Background
- Track Component Description
- Accident Cause Analysis
- Track Inspection Trip
- Area of Focus: Turnouts
- Data Collection Trips
- Summary
Background

- Track inspection is a costly and labor-intensive process, which utilizes valuable track capacity.

- Track inspection does not produce consistent results and relies solely on the inspector’s alertness and experience.

- Machine Vision provides a solution to efficiently, effectively, and objectively inspect many track components for defects.
  - It uses camera images and videos, along with computer code, to detect key features in these images.
Machine Vision Track Inspection Results

- UIUC has successfully developed algorithms to detect spikes and rail anchors

- Expanding focus area to provide robust inspection of track components, such as turnouts
Special Trackwork - Turnouts

Three main components: Switch, Guardrail, Frog

- Switch: Allows train to use diverging tracks
- Guardrails: Keep wheels aligned properly when passing through turnout
- Frog: Allows for wheel flanges to cross through rail
Critical Causes of Accidents

- According to the Federal Railroad Administration (FRA) Accident Database, the top three causes of accidents in turnouts are:
  - Switch point worn or broken
  - Switch point gap between switch point & rail
  - Switch damaged or out of adjustment
- Turnouts account for almost 10% of all rail accidents
- Nevertheless, turnouts are expensive track components and turnout-caused derailments are often severe
Inspection – High Rail Visit

- A track inspector performs an inspection twice a week on this type of track
- Examines key track components
- Observations from my visit
  - Only on main track / track in good condition
  - Veteran track inspector / only inspects critical track conditions
  - Poor viewpoint from truck
Turnouts: Specific Areas of Focus

- **Switch points**
  - Distance from stock rail when open and closed
  - Worn point
  - Missing cotter pins
- **Point of frog**
  - Worn or broken point
- **Guardrail**
  - Distance from rail
Field Training and Data Acquisition Trips

• BNSF Railway field visit:
  – Traveled to Sibley, MO with U of I Railroad Engineering students
  – Used Machine Vision to examine intermodal loading efficiency
  – Gain introductory experience with video recording software

• Monticello Railway Museum field visit:
  – Traveled to the Monticello Railway Museum and become familiar with data acquisition techniques
  – Implemented laboratory research experience in field environment
Data Collection – Video Track Cart

• Used Video Track Cart for preliminary field data acquisition

• Two views for camera angles
  – Over the rail view: to check distances through turnout
  – Lateral View: to check missing or loose parts

• Cameras mounted on tripods for precise adjustment and angle measurement

• Durable laptop for outdoor use

• Future data will be gathered from a high-rail vehicle
Personal Accomplishments

• Performed an accident analysis from derailments information in the FRA Accident Database

• Developed a turnout inspection procedure to be used in data acquisition trips

• Led a research team on a video collection trip

• Gained a better understanding of track components
Collaborative Research Team

Computer Vision and Robotics Laboratory:

Narandra Ahuja, Professor, Electrical and Computer Engineering
John M. Hart, Senior Research Engineer, Beckman Institute
Esther Resendiz, Graduate Student, Electrical and Computer Engineering

Railroad Engineering Program:

Chris Barkan, Professor, Director of Railroad Engineering Program
Riley Edwards, Lecturer, Railroad Engineering Program
Steven Sawidisavi, Graduate Student, Civil and Environmental Engineering
Bryan Schlake, Graduate Student, Civil and Environmental Engineering
Tristan Rickett, Graduate Student, Civil and Environmental Engineering

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Questions?