LYNXRAIL

Technology With Vision

AUTOMATED HIGH-SPEED VEHICLE INSPECTION SYSTEMS

A TECHNICAL OVERVIEW OF FACTIS™ SYSTEMS

www.lynxrail.com

What is FactIS™?

- FactIS™ stands for Fully Automated Car Train Inspection Systems. In Australia, the systems are known as ATEx systems (Automated Train Examiner Systems)

- FactIS™ consists of a suite of modules that can be used individually or as a composite system

- Main features:
  - Trackside data capture
  - Machine vision used for most modules
  - Near real-time data processing & analysis (completion time depends on length of train)
  - Automated reporting
  - Exception reports (critical events)
  - Images of components can be reviewed visually for QA or investigation purposes
  - Data can be used for trending (wear patterns) and maintenance planning
  - Minimal track disturbance (no pits or special infrastructure required)
  - Trains can pass at full speeds (currently up to 120 km/hr, but some modules were tested and found to be working at speeds up to 160 km/hr)
  - Systems can be installed at almost any location along the line
  - Systems are impervious to most environmental conditions

Why use automated Systems

- Automated Wayside systems replace both long-term and immediate inspections
- “Objective” monitoring – no subjective judgments need to be made, as with traditional inspections
- Monitoring is 24/7
- Critical events are identified rapidly
- Borderline criticals can be managed / equipment can be operated longer when placed on “watch list”
- Manual on-screen review can supplement automated review if image cannot be processed (for example, if there is an impediment, such as inclement weather, which prevents automated processes from successful analysis)
- Cost-effective to operate, as it replaces costly roll-by and stationary vehicle inspections, replaces cyclical inspections
- Lets operator switch from periodical maintenance to targeted maintenance

More and better information = safer railroads

Early example of the benefit of automated monitoring systems

A wheel set with two newly machined wheels was introduced at the end of December 2002. This is what happened to the two wheels over less than four months:

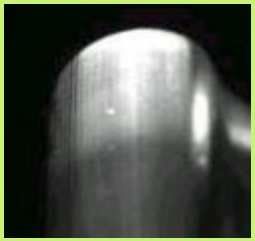
Left wheel

32.5 mm

Newly machined flanges

December 28, 2002

Right wheel



32.5 mm

21 mm

56,000 km later

April 18, 2003

32.5 mm

Some system /development milestones

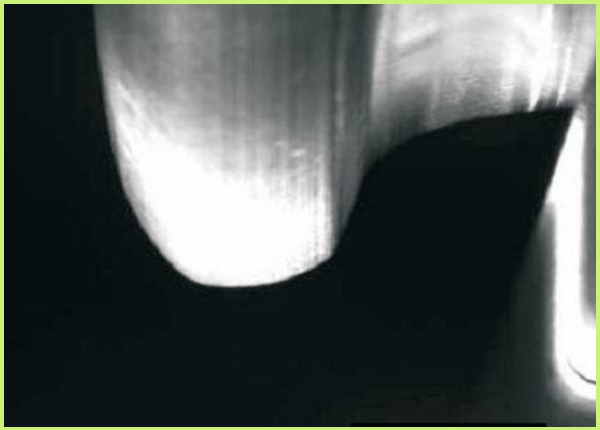
1998	R&D started
2000	First prototype system installed for BHPB in Australia
2002	Production system introduced to BHPB maintenance
2004	-- Hunting Detector tested by FRA, found to be most accurate of detectors tested, especially at low speeds -- R&D on high-precision Infrared scanner for brake shoe application
2006	Started R&D on IVCM (Integrated Video Capture Module)
2008	High-precision infrared scanner / brake shoe module tested to see if it could replace 1000 mile inspection of brakes
2010	IVCM is introduced into new systems. • Replaces need for computer-based data acquisition. • Lightning protection on trackside equipment is no longer required. • Only 1 computer is required at the installation

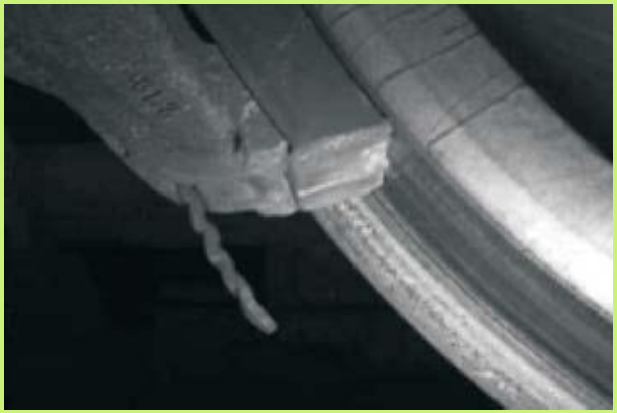
Typical architecture of FactIS™ system

- A typical FactIS™ system consists of:
  - An advanced triggering module that surveys the geometry of each vehicle to determine the best triggering technique in order to assure the highest image quality at every speed.
  - Cameras and high-speed, high-power strobe lighting
  - Image capture repository
  - AEI module for vehicle identification
  - High-speed telecommunication connection
  - Image processing modules, either trackside (older systems) or at the end of the high-speed telecom link (IVCM systems)
  - Data base repository
  - Interface for condition monitoring software for self-diagnostics and maintenance of system

Current system modules

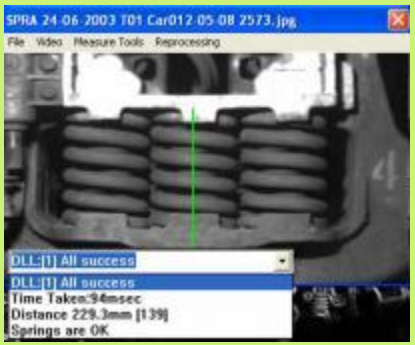
- Wheel Measurement system:
  - Flange height
  - Flange width
  - Vertical flange
  - Hollowing depth
  - Rim thickness
  - Wheel diameter
  - Back-to-back
  - Angle of attack
- Brake Pads:
  - Thickness (top and bottom)
  - Missing pad





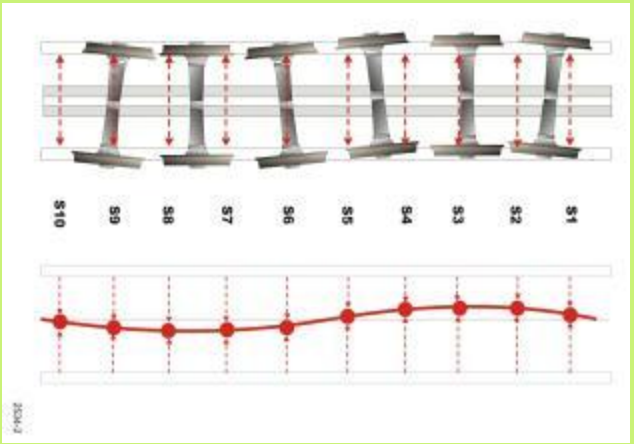
Current system modules (cont'd)

- Springs
  - missing, broken, uneven loading
- End caps
  - presence of bolts, bearing adapter wear & pinching
- Couplers / draught gear
  - slack and alignment
- Undercarriage components
  - coupler pin support, other mechanical components
- Handbrake application
  - checks if applied or not
- Others can be added
  - may need additional development / modification



Current system modules (cont'd)

- Hunting Detection
  - Detects hunting vehicles.
  - Identifies vehicles with a propensity to hunt (even with train travelling at low speeds.
  - Angle of attack
  - Tracking bogies
  - Bogie geometry



FactIS™ - in harsh environments

Dust and heat

Humidity & water

Snow & cold

Current Installations

FactIS™ systems are currently installed on railroads in:

- Australia
- Brazil
- Canada
- USA

Contact Lynxrail for further details