



International Electronic Machines Corporation Smart Infrared Inspection System

Commercial Motor Vehicle Roadside Technology
Corridor Safety Technology Showcase

October 14, 2010



Commercial Motor Vehicle Roadside Technology Corridor



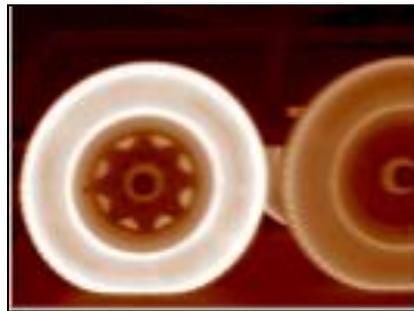
Smart Infrared Inspection System (SIRIS)

- Grant for a demonstration of thermal imaging technologies
 - Identify, in real time, faults and failures in tires, brakes and bearings mounted on commercial motor vehicles
 - Employ system along the interstate
 - Explore whether statistical tools can be developed that can predict impending tire, brake, or bearing failures



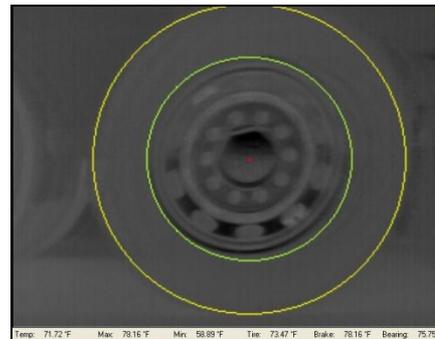
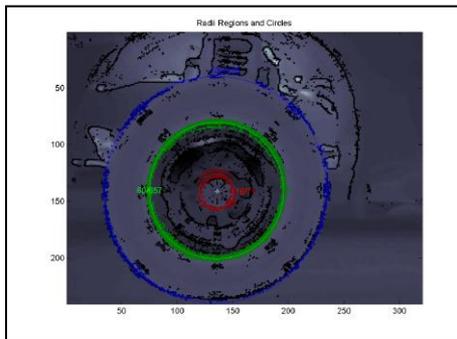
SIRIS – Details

- \$1.4 M Research Grant
- 3-year Project
- Grant competitively awarded September 2006 to IEM, Inc. of Troy, NY
- Supplemental \$500K from NYSERDA for improved high speed performance



SIRIS – Concept of Operations

- Measure wheel temperatures on passing vehicles
- Segment wheels into areas of interest
- Automatically flag those meeting certain criteria
- Alert inspectors when vehicle is flagged



SIRIS – Field Tests and Demonstrations

- Early prototype demonstrated Summer 2007
- Field data collection in New York and New Jersey during 2008
- Demonstrated in Spring 2009
- Conducted Operational Test in Summer 2009
- Installed at Greene County Weigh Station December 2009
- Currently in long-term validation testing by ORNL

SIRIS User Interface

- System triggers on wheel ends and looks at both sides of the vehicle
- System looks at three areas specifically:
 - Tire
 - Wheel (brake area)
 - Hub
- *Automatically* evaluates each vehicle and alerts when problem noted
- Vehicles currently identified by image during inspection
- Currently works at speeds up to about 20 mph



Current SIRIS User Interface

(this vehicle placed OOS)

Live Demo

- Have Tractor drive through

Operational Test Outline

- Location: Greene County Weigh Station; part of FMCSA Roadside Technology Corridor
- Dates: July 23 through August 5, 2009
- Support: Tennessee Department of Safety and Tennessee Department of Transportation

Operational Test Procedures

- All vehicles diverted to pass SIRIS
- Speed limited to 10 mph though actual speed past system closer to 20 mph
- SIRIS sounded audible alert when it flagged a vehicle
- Report printed and handed to inspector
- All Brake flags subject to Performance-Based Brake Tester (PBBT) and Level 1 Inspection
- All Tire and Bearing flags subject to Level 2 Inspection

Test Protocols – Brake Flags

- Flags based on algorithm that compares relative temperatures of all segmented “brake regions” on vehicle
- Considers following factors:
 - Temperature variability between all wheels
 - Temperature relative to ambient temperature
 - Temperature relative to other wheel on same axle

Test Protocols – Tire and Bearing Flags

- Tire Flags
 - Flag based on tire temperatures relative to others on same vehicle and ambient temperature
 - Pressure gauged first in ‘flagged’ tire; then inner tire
 - If no problem found, gauged tires on opposite side of axle
 - Air bag checked
- Bearing Flags
 - Flag based on bearing temperature relative to ambient temperature for each wheel
 - Hand-held IR thermometer used to gauge bearing temperature and checked

Summary Results

Total Vehicles Scanned by SIRIS	4,373
Total Vehicles Automatically Flagged by SIRIS (%)	359 (8.2%)
Flagged for Brakes	328
Flagged for Tires	29
Flagged for Bearings	2
Total Vehicles Subject to Vehicle Inspection	305
Total Vehicles Placed OOS for Reason Directly Related to SIRIS Flag	193 (63.3%)
Total with Any Flaw Found (includes both OOS and others flaws not meeting OOS criteria)	234 (76.7%)

Detailed Results by Type of Flaw

Type of Flaw Detected	Inspections	OOS	Related Issue or Violation	No Violation
Brakes	274	174 (63.5%)	33 (12.0%)	67 (24.5%)
Tires	29	18 (62.1%)	8 (27.6%)	3 10.3%
Bearings	2	1 (50.0%)	0	1 (50.0%)
Total	305	193 (63.3%)	41 (13.4%)	71 (23.3%)

Brake Flaws Detected

- Types of Brake Flaws Detected
(Data from Level 1 Inspection Reports)

– Brake Adjustment	118 Vehicles	236 Wheels
– Brake Failure	116 Vehicles	1,145 Wheels
– Inoperative Brakes	45 Vehicles	110 Wheels
– Inadequate Brake Lining	32 Vehicles	53 Wheels
– Brake Connection Leak	23 Vehicles	86 Wheels
– Cracked Pads	14 Vehicles	26 Wheels
– Cracked Lining	13 Vehicles	23 Wheels
– Air Chamber/Air Leak	13 Vehicles	18 Wheels
– Other Issues	64 Vehicles	110 Wheels
(each <10 Vehicles/Wheels)		

Note: Total exceeds number of vehicles inspected due to multiple violations on same vehicle

Tire and Bearing Results

- Tire problems detected included:
 - Underinflated and flat tires
 - Tire tread
 - Deflated air bag
- Only 2 vehicles flagged during Operational Test
 - One found to have oil leak in wheel bearing

Current Validation Program

- Vehicles selected randomly.
- Blind Test, inspector does not know if vehicle was flagged by SIRIS
- Approximately 10% flagged by SIRIS
- Preliminary finding show nearly 90% OOS for SIRIS flags and nearly 95% for some flaw
- Statistically, vehicle flagged by SIRIS has very high likelihood of being placed OOS

SIRIS Benefits

- SIRIS is fully automated
 - Does not require that an operator sit and monitor the screen.
 - Able to run 24 hours a day, 7 days a week
 - Evaluates every vehicle that passes through
- SIRIS images the wheels on both sides of the vehicle as it passes through unlike other commercially available systems.
- SIRIS is less expensive than the currently available van based thermal imaging systems.
- SIRIS can be configured for fixed facility or transportable use
- SIRIS uses actual temperature readings for its analysis of the wheel components rather than artificially scaled temperatures for greater accuracy.
- SIRIS can be set to remain silent until a vehicle is flagged. The system will then activate the screen and will sound an alert signal to get the attention of inspectors.

Examples

- Show examples of different inspections based on recent Level 1 inspections