Duos Technologies

Intelligent Railcar Inspection Portal – rip®

Arco de inspección
Railcar Inspection Practices

• Inspection practices require an inspector to visually inspect the mechanical components on both sides of each car in a train.
• Inspection efficiency and effectiveness varies depending on conditions and capability of inspectors.
• Time Consuming!
High Speed, High Resolution Imaging technologies are now utilized to create the Intelligent Railcar Inspection Portal – rip®
Modular and Scalable System

- Top Linear Panoramas \textit{xtd}™
- Side Linear Panoramas \textit{xtd}™
- Truck (Lower Side) Panoramas \textit{xtd}™
- \textit{vue}™ Vehicle Undercarriage Examiner
- Oblique Cameras System
- OCR Cameras System
- Open Door/Open Hatch Systems
- Precision Linear Speed Sensor (PLSS)
- \textit{trids}™ Detection System
- Structured LED Lighting Subsystems
- Car Cutting Subsystem
- AEI/RFID Reader w/Dual Antennas
- Environment controlled signal hut
- Canopy
- Virtual Fence
**rip® Railcar Inspection Portal**

- Duos Technologies’ xtd™ Extreme True Definition Technology
  - High Resolution Images for precise visual mechanical and safety inspection
    - Resolution up to 224 Megapixel images per railcar for image capture.
- High Precision Linear Speed Sensor
  - Allows for synchronized system capture at increased speeds up to 110 km/h
- Machine vision sensors that operators view utilizing centraco™ platform
- Provides Multiple View (360°) Inspection
- Allows Visual Manual and Automated Detections for Mechanical, FRA Safety and Security Inspection Criteria
- AEI/OCR System Synchronization and Verification
- Remote Management and Viewing
Lower Panorama Image

LIFT AND JACK HERE

2 INCH TREAD COND. SHOES
r iP® High Resolution Inspection

Undercarriage Images
r tp® High Resolution Inspection
Truck Geometry Inspection
Air Hose Droop and Criteria
Automated Detections are evolving through the use of Neural Network Algorithms

- Neural networks are computer programs assembled from millions of artificial brain cells that learn and behave in a similar way to human brains.
- The system processes information by their response to external inputs, much like the way the human brain works.
  - It sees an object and then interprets that object. Over time it learns from what it sees.

This unique visual intelligence learning allows us to process images collected from the portal to apply custom requirements for mechanical, FRA safety and security criteria for automated detection.
Neural Network Algorithm and Development:

- Algorithms Available:
  - Automated Identification of Structural Components (AISC)
  - FOD - Foreign Object Detection (image comparison – size of difference filters)
  - Optical Character Recognition (OCR) of railcar number
  - Missing Bolt Detection - Carrier and Safety plates (on select cars and types)
  - Cross Bearer Inspection
  - Truck Bolster Inspection
  - Open Door detection
  - Open/Missing Hatch detection
  - EOT device not at end (AEI tag group code)
  - Air Brake Hose height (below 5” or above 9”)
  - Car Type Identification (Silhouette)
  - Placard identification
• **Truck Bolster Tilt Angle / Truck Springs Geometry**
  - Comparison of near to far side imagery to determine tilt of car or truck bolster/springs

• **Truck dots counter** – Reads dot markings on trucks. Used for ensuring trucks on a rail car are matched properly.
  - Left truck crop
  - Right truck crop

• **Placards on sides and OCR** – this combination of two algorithms first detects placard on a train car and then deciphers the contents based on an OCR read.
  - Placard ROI
  - Placard classification

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**rip® Neural Network Algorithms**

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EXPORAIL XVI-2017
• Safety and Security Inspection
• Captures, Inspects and Processes Real Time Images
• Detects Individuals
• Identifies Location Within Train Consist
• Automatically Transmits Alarms
centraco® User Interface

- centraco® - an Enterprise Information Management Tool
  - Web based application

- Customer Driven Concept of Operations
  - Optimized Workflow for increased situational awareness, rapid response and forensic analysis

- 3rd Party Technology Integration
  - Allows seamless integration of multiple wayside and information systems into a unified interface

- Integrated Alarm Management

- Autocheck - Monitors health and status of all connected devices and network

- LDAP/Active Directory integration

- Secure Platform - Data transmitted over HTTPS using 2048 bit (or higher) encryption
• Captures images at speeds up to 110km/h
• Produces images within seconds
• Four-sided (360°) Visual Inspection

• Image Synchronization of All Views
• Automated Alarm Management
• Report generation/distribution

**centraco® User Interface**
centraco® Inspection Tools

- Inspection Mode Tool
- Allows Detections Identified/Stored

- Inspection Validation
- Allows Zoom Inspection
centraco® Inspection Tools
Automated Open/Missing Hatch Detection
• Identifies Rail Hopper Cars Missing Top Hatches
• Identifies Location Within Train Consist
• Automatically Sends Alarm to Operators/Inspectors

Automated Open Door Detection
• Identifies Open Doors
• Identifies Location Within Train Consist
• Automatically Sends Alarm to CBP
**Automated Detection Example**

- Open Door Detection
- Alarm Highlighted in Consist List
- Allows Inspection Validation
- Detailed Views
centraco® Inspection Tools

- Validation Screen
**centraco® Inspection Tools**

- Detailed View of Detection
Automated Detection Example

- Open Hatch Detection
centraco® Inspection Tools

- Validation Screen
• Detailed View of Detection
Automated Detection Example
• Air Hose Droop Validation Screen
centraco® Inspection Tools

• Detailed View
**centraco® Inspection Tools**

- Optical Character Recognition
- Allows AEI Verification/Match
ripi® Cloud Services

- Anytime, Anywhere service delivery model based on a multi-site, multi-tenant, shared and virtualized architecture in all its layers
- Provides technology solution to securely isolate shared computing, network and storage services.
  - Centralized Data Repository
  - View from anywhere/anytime
- Administers and manages cloud services with an ad hoc secure perimeter for each client
  - Simultaneous System Access by Authorized Users via Secure Socket Layer VPN (SSLVPN) via Secure Web Portal
- Scalable solution
Over 60 Additional Algorithms

- Secured Pipe - Alignment
- Bulk Cargo Overhang
- Roller bearing adapter failure
- Sill Step Status
- Grab Irons Status
- Missing Valves
- Broken Train line air hose assemblies

- Bottom outlet doors, bottom outlet door attachment
- Leak/Liquid Detection
- Coupler retaining pin/ cross key
- Brake rigging, brake components, hand brake linkage
- Truck side frame cracks
- And more......
Laser Technology

• 2D Scanner
  ▪ Frequency
  ▪ Data points per scan
  ▪ Resolution

• Protocol
  ▪ Real-time data over Ethernet
  ▪ Discreet digital output
Laser Output - Top
Laser Output - Top
Laser Output - Side
rip® Expansion Technologies
Under Development

Light Detection and Ranging (LIDAR)
• 3D 360 Degree Field of View
• High Resolution Inspection
• Track Intrusion Detection
• Grade Crossing Protection
tvue™ Thermal Vehicle Undercarriage Examiner

• High speed thermal imaging camera system with cooled InSb (Indium Antimonide) detectors that automatically monitors the thermal signatures of railcar/locomotive components.
  • Monitors components that are visible on a line of sight from below the locomotive.

• Monitors undercarriage components that undergo temperature changes while the locomotive is operating.
  • Automatically identify components and assess component thermal signatures on railroad cars/locomotives operated over the system
  • Components monitored include traction motors, motor bearings, gear drives, brakes, wheels, bearings, and power cables.
rip® Expansion Technologies
Under Development

tvue™ Thermal Vehicle Undercarriage Examiner
riptm Railcar Inspection Portal

Technology to:

• Increase Safety
• Increase Security
• Increase Inspection Productivity
  • Streamlining Inspection Practices
  • Improve Efficiency
  • Reduce Dwell Times
  • Increase Velocity
Railcar Inspection Portal