Radar-Based Vehicle Detection for Four-Quadrant Gate Crossing Warning Systems

Tom Hilleary, Island Radar Company, LLC
Radar-Based Vehicle Detection - History

Expected Benefits

- Ease of Installation
- Work Crew Safety
- Maximize Coverage
- Longer Life
- Immunity to Elements
- Reliability
- Potential Redundancy
SmartSensor Matrix

**Wavetronix® SmartSensor Matrix**

- 16 separate radars in each sensor, no scanning
- 90° x 140-foot detection pattern – 15,386 ft²
- MTBF > 10 years, MTTR < 6 hours, 99.99% Availability

Proven in ITS traffic intersection control
Moving and stationary vehicle detection
Multiple radars (up to 8) can be used together
Proposed Dual Radar Implementation
Proposed Dual Radar Implementation
# Radar, Controller, and Functional Changes

<table>
<thead>
<tr>
<th>AREMA Compliance per Class C Equipment</th>
<th>Environmental - Temperature, Humidity, Mechanical, EMI/RFI, Surge, &amp; EFT Channel-to-Channel and Earth Ground Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital Architecture</td>
<td>“No Single Point of Failure” \nIndependent Radar Processors with Supervisory Processor \nIndependent Radar Channel Health Outputs</td>
</tr>
<tr>
<td>Additional Configuration Options and Functions</td>
<td>Add USB and Ethernet Embedded Server \nAdd Radar Response Detail (Trackers) to Configuration Application \nAdd Dual Radar Tracking Metrics</td>
</tr>
<tr>
<td>Reliability Enhancements</td>
<td>Accelerate Message Rates \nAdd Bi-Directional Vehicle Detection \nAdd Sensor Movement Detection(^2) \nAdd Heavy Weather Optimization Features(^1) \nProvision for Vital Implementation(^2)</td>
</tr>
<tr>
<td>General</td>
<td>Eliminate Queue Forming Feature(^1) \nFailsafe State Reversal \nSingle, Application-Specific Enclosure vs. Open Frame Architecture</td>
</tr>
</tbody>
</table>

\(^1\) Current systems under 3\(^{rd}\) party long-term testing, still in process or results not yet reported

\(^2\) Version 3 VDR24 hardware
Configuring/Verifying Detection Zones
Recent Additions and Feature Enhancements As A Result of Railroad Implementation

- **Vital Applications**
  - Uses redundant radars’ individual detection zone outputs
  - A vital processor verifies radar correspondence

- **Sensor Movement Detection**
  - FRA suggestion
  - Supervisory processor senses abrupt changes in correspondence
  - Provided through a separate health output
Additional Railroad Applications

- Blocked Hwy-Rail Crossing Detection and Notification
- Train Detection for Hwy-Rail Crossing Activation
- Train Detection at Rail Crossovers
- Switch Fouling Prevention in Classification Yards
Train Detection at Highway-Rail Crossings
Train Detection for Crossing Activation
Train Detection at Diamond Railroad Crossings
Train Detection in Classification Yards
Current Status

- Mature technology in the ITS sector
- Two years of development and testing for railroad
- Multiple railroad applications deployed
- Several third party validation studies in process