MassDOT Asset Management

Data Collection Opportunities

ED NARAS
PAVEMENT MANAGEMENT ENGINEER
MASSDOT – HIGHWAY DIVISION
4/30/2024
New Data Collection System

- HICAMS IV
- Pathway Services
- Data Collection over the years
  - 1987 ARAN (Bumpy 3)
  - 1994 ARAN (HICAMS I)
  - 2002 ARAN (HICAMS II)
  - 2012 PathRunner (HICAMS III)
  - 2024 PathRunner (HICAMS IV)
HICAMS (aka. “PathRunner”)

massDOT
Massachusetts Department of Transportation
Highway Division
HICAMS (aka. “PathRunner”)
HiCAMS Subsystems

- 3D Pavement Analysis Subsystem
- South Dakota-Style Inertial Profiler
- Distance Measurement Instrument-LRS
- Right-of-Way Imaging Subsystem (3+1)
- GPS
- “HD LiDAR” Scanner
- IMU (Inertial Measurement Unit)
- Web-based reporting & viewing
- Geospatially Integrated
- Pavement Data directly connected to RIF.
System Storage & Controls
Location
Inertial Navigation System (INS)

- Heart of the location system
- Able to operate in environments where GNSS is not available due to outage, buildings, tree canopy & tunnels
- Integrated with Distance Measurement System (DMI), LiDAR, & GPS
- Post processed with local base stations (and soon MassDOT Cores network)
4K Roadway Camera Array
3D Pavement Analysis System (3D-PAS)
Pavement Imaging - 3D-PAS vs 2D Images

- Same Lane
- Same Pass
- Effectiveness of the 3D system in
- Note intensity of pavement markings
AutoCrack & AutoClass Process

1. Capture 3D Image Data
2. Identify Lane Markings
3. Identify Wheel Paths
4. Locate Crack Pixels
5. Determine Crack Orientation
6. Translate to Distress Boxes
7. Label Distresses and Associated Severities

3D DISTRESS AUTOCRACK / AUTOCCLASS PROCESSES
• Pathview is the desktop software used for generating the most detailed reports
• Pathweb is the web based software slated for department-wide rollout
## 2022 Interstate Pavement Distress Summary

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<td>3</td>
<td>7.2</td>
<td>7.2</td>
<td>7.2-7.2</td>
<td>Yes</td>
<td>HMA</td>
<td>2017</td>
<td>-186.0</td>
<td>-1028.6</td>
<td>-125.0</td>
</tr>
<tr>
<td>I-90</td>
<td>West Stockbridge</td>
<td>1</td>
<td>0.0</td>
<td>2.7</td>
<td>2.7-2.7</td>
<td>Yes</td>
<td>HMA</td>
<td>2016</td>
<td>263.7</td>
<td>-563.3</td>
<td>-100.0</td>
</tr>
</tbody>
</table>

### Notes
- ALIG LOW: All Issues Low
- ALIG MED: All Issues Medium
- ALIG HIGH: All Issues High
- ALIG TOTAL: All Issues Total

---

**Table Notes:**
- QC: Quality Control
- HMA: Hot Mix Asphalt
- GGF: Gravel Graded Fill

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**Column Headings:**
- Route: Interstate Route
- Location: Location Name
- District: District Number
- Patrolnummner From: Patrol Number From
- Patrolnummner To: Patrol Number To
- From To: From To Range
- Needs Further QC: Needs Further QC
- SURFACE TYPE: Surface Type
- YEAR PAVED: Year Paved
- PREVIOUS YEAR: Previous Year
- PREVIOUS YEAR DISTANCE: Previous Year Distance
- PREVIOUS YEAR DISTANCE: Previous Year Distance
What Roadways are tested?

- State Numbered Routes
- NHS
- End to end
- Interstates
- N-Roads
- Regardless of Jurisdiction
LiDAR
(Light Detection and Ranging)

- Single LiDAR Scanner
- 267 Profiles per second (16,000 RPM spin speed)
- 0.2mm accuracy 1-25meters.
- 182M range
- 1.094M points per second
- 1 Trillion data points collected during our 2023 network survey
- With 4x cameras onboard, point cloud images can be colorized.
PATHPOINTS LiDAR
Cloud Hosted Viewing
Point Cloud Colorization

POINT CLOUD COLORIZATION SETTINGS FOR DATA MANIPULATION
PathPoints Tools:

- Width Measurement
- Height Measurement
- Surface Area Measurement
- Semi-Automated Minimum Vertical Clearance Measurement
- Semi-Automated Minimum Horizontal Clearance Measurement
- ADA Ramp Analysis
- Cross Slope Analysis
- Sign Reduction
LiDAR Use Cases

BILLBOARD INVENTORY

TREE/VEGETATION REVIEW

HORIZONTAL STRUCTURE ANALYSIS

INTERSECTION EXTRACTION

RETAINING WALL MEASUREMENTS

STATEWIDE ASSET INVENTORY PROJECTS
Asset Classification Guides
“PATHPOINTS” Interface with Asset Window

- File Exports
  - .SHP, .KML/KMZ, XLSX, .CSV
Direct Exports & Reporting

Direct EXPORTS and REPORTS from PathPoints LiDAR Extracted Asset Database

FILE EXPORTS: .SHP, .KML/.KMZ, .XLSX, .CSV
Measurement of Bridge Clearances
Potential Additional LiDAR Uses

• Ongoing Efforts & Research
  • Sidewalk condition assessment
  • Pavement Marking Retroreflectivity
  • Supplement Ground Surveys
• Resurfacing & Preservation Program
  • Superelevation
  • Cross slope
  • Drainage issues
Pavement Friction & Texture Signature Pilot

- Safety
- Maintenance, Preservation, & High Friction Surface Treatments
- Potential for Network Level Data Collection
- What is Texture Signature??
- Small Scale Pilot Project comparing smooth vs ribbed Skid Number vs. Texture Signature.
Texture Signature - Pilot

- Different from Mean Profile Depth Analysis (MPD), which has several known weaknesses.
- Collects 5000X the amount of data as current macrotexture systems at 5 times resolution.
- Enables Network-Level texture collection.
- Texture Signature closely correlates to Pavement Skid Number (FN40)
- Collect texture profiles every 1/3 inch instead of once every 10 meters. Comparing ½ a million data points vs. 100 in a 10m area as in MPD data collection.
- The system “bins” every data point and evaluate every change in height between each data point.
- The system creates reports at any interval to as small as a foot.
- The system can plot texture data spatially, just like any other type of data collected network-wide. It can be plotted against other relevant data sets like curvature and vehicle speed for a texture, road geometry-vehicle speed study.
- In this pilot, the data will be collected simultaneously with pavement condition data, making the cost to collect data versus locked wheel skid resistance testing much lower.
- Data can be collected annually network-wide to evaluate the change to texture over time and track the performance of areas where pavement treatments have been applied.
- Data can be collected in three zones: RWP, Center of the Lane, and LWP for an analysis of pavement wearing, bleeding, and raveling.
Texture Signature

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>TEXTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LWP</td>
<td>MICRO</td>
</tr>
<tr>
<td>CENTER</td>
<td>MACRO</td>
</tr>
<tr>
<td>RWP</td>
<td>MEGA</td>
</tr>
</tbody>
</table>

PROFILE HEIGHT RANGES (mm)

1 0.0 - 0.1 (micro)
2 0.1 - 0.2
3 0.2 - 0.3
4 0.3 - 0.4
5 0.4 - 0.5
6 0.5 - 0.8 (macro)
7 0.6 - 0.7
8 0.7 - 0.8
9 0.8 - 0.9
10 0.9 - 1.0
11 1.0 - 2.0
12 2.0 - 3.0
13 3.0 - 4.0
14 4.0 - 5.0
15 5.0 - 8.0 (mega)
16 6.0 - 7.0
17 7.0 - 8.0
18 8.0 - 9.0
19 9.0 - 10.0
20 > 10.0

Profile Height Range Intervals

AVERAGE MPD:

LWP = 0.546mm (STD 0.117)
CEN = 0.647mm (STD 0.102)
RWP = 0.658mm (STD 0.141)
2024 Planned Enhancements

- Single Sign On for PATHWEB for easy DOT-wide access.
- 360 Spherical Imaging collected this summer. (think “Google Street View”)
- 360 Spherical Imaging integrated with Pathpoints & LiDAR.
- Improve software integration between Roadway viewer, mapping & LiDAR applications.
- Expanding Data Collection Network to include Ramps and Interchanges (never before collected)
- Work with vendor to correlate texture signature to pavement friction data on interstate highway network.
- Give us your ideas…
- Help us prioritize…
Endless Possibilities?

• LiDAR intensity vs 3D Cracking system for evaluating retroreflectivity.
  • Various retroreflectivity measuring devices are being evaluated for network level data collection.
• Increased accuracy of elevation data using survey controls prior to LiDAR Data Collection.
• Overlaying Pavement Texture data with crash locations for safety assessment.
• Asset Extraction.
  • Initially Labor Intensive to QC.
  • How about updates.
Challenges

• Storage anticipated for 2024
  • 3D-PAS
  • HD ROW Images
  • LiDAR
  • 360 Imaging
• 90TB per year
• Signature Texture +++
• Historical Data (back to 2018)
• How do we provide quick & easy access for all?
Where is this data?

• Raw & finished data storage hosted and backed up at vendor data centers.
• Software, web hosting, licensing & tech support under annual contract.
  • Vendor assists with data analysis.
    • Pavement Imaging post-processing
    • Lidar Post Processing
    • Opportunities to utilize data extraction.
• Big data moves by external drives.
• Working on it…
• FYI - Data is owned by DOT.
  • Vendor not reseller of data.
Questions?
• **Pathweb**

• **Pathpoints**
  • [https://ma.pathpoints.pathwayservices.com](https://ma.pathpoints.pathwayservices.com)

• **Pwext\MassDOT**
  • MA-DOT_2022
  • enaras
  • Pavement_2024
  • [https://pathweb.pathwayservices.com/ut/sections/6023/locations/0](https://pathweb.pathwayservices.com/ut/sections/6023/locations/0)