

# Rapid 1-mm Survey of Airport Runways with Laser Imaging Technology

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# Presentation Outline

- Needs of Airport Pavement Condition Survey
  - Laser Imaging Technology
  - Software Solutions
  - Atlanta (ATL) Pavement Projects
  - New Technology & Conclusions
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# Current Methods for Airport Runway Condition Survey

- PCI Based Visual Survey
  - Predominant Method Worldwide: Walk Manual Survey
  - Information: surface visual data
  - Problems
    - Daytime Survey Only, Runway Shutdown
    - Human Errors: not easily correctable
    - Time Consuming
    - Issues in Consistency, Repeatability, et al
    - No High-Definition Visual Data for Future Use
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# UK HARRIS (Highways Agency Road Research Info System )



- Multi-Function
  - Automation of Cracking Survey
    - Primarily Image Collection
    - Automated Detection and Classification of Cracks: Not in Production
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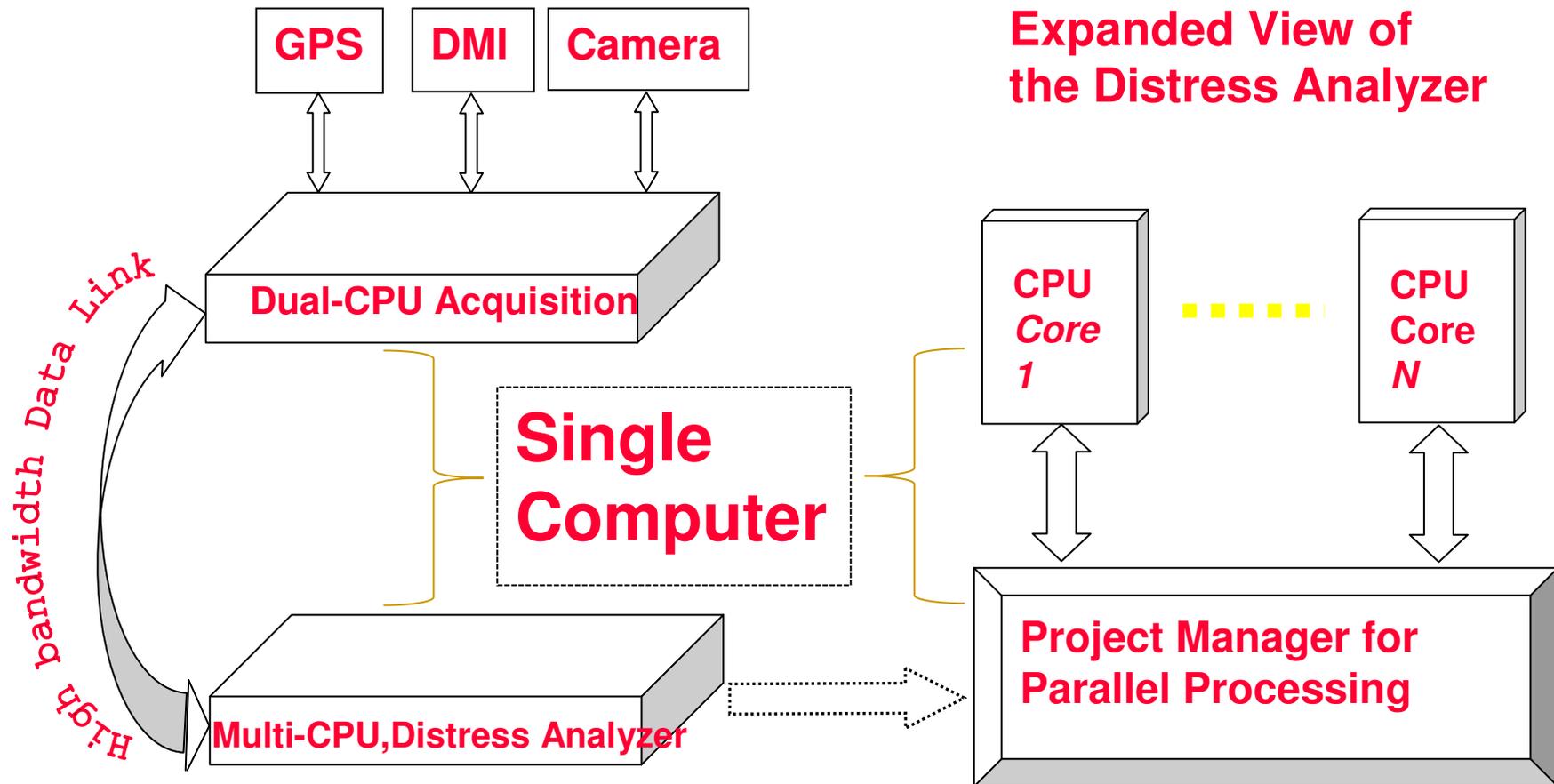
# Australian RoadCrack, RTA & CSIRO



# Digital Highway Data Vehicle (DHDV, Old Generation)



# The Parallel Computing Approach (Same General Structure for over 10 Years)



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# Computing and Positioning

- Evolving Computing Hardware
    - Multiple CPU & Multiple Core, resulting in Higher Performance with Single Computer
    - Reduction in Power Usage
  - Positioning Devices
    - DMI: for both the laser imaging triggering and distance calculation
    - Differential GPS receiver: sub-meter accuracy at 10Hz frequency
    - Supplemented with Hi-Frequency IMU for 1-inch dynamic accuracy
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## New Laser based Illumination

- 1-mm Resolution
  - Complete Pavement Coverage, 4-meter Wide
  - Any Weather Condition as long as Pavement is dry (Night Operation OK)
  - No Shadows under Any Lighting Condition
  - Uniform Image Quality
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# DHDV with LRIS (Laser Road Imaging System)



# DHDV with LRIS (June 2008)

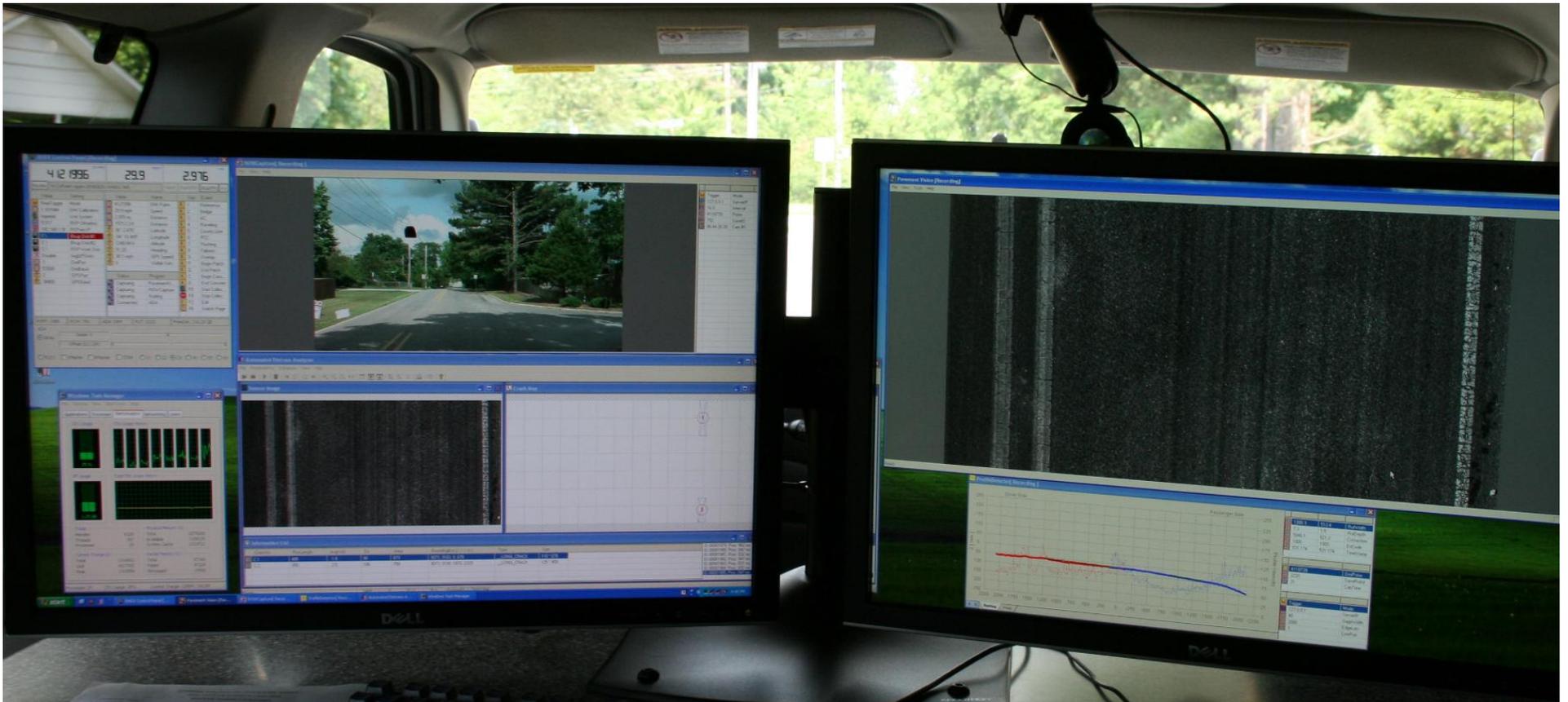


# Low Power Consumption, 800Watts



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# During Data Collection



# Workstation for Post-Processing



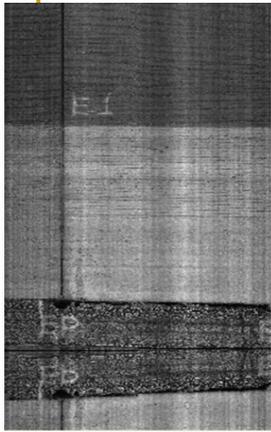
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# Airport Runway Surveys

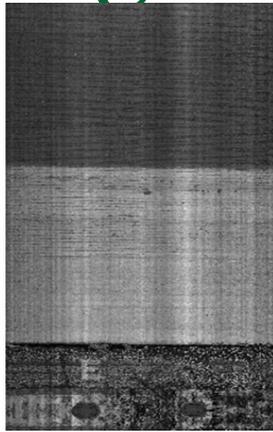
- Atlanta Airport, ATL



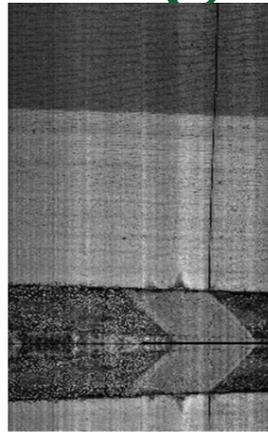
# Stitching of Images from Many Passes



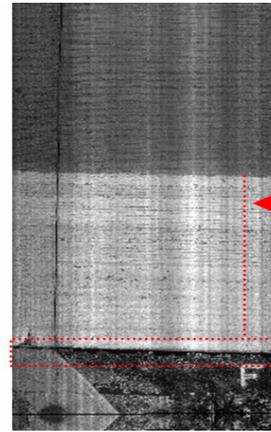
Runway 8L  
WE E1



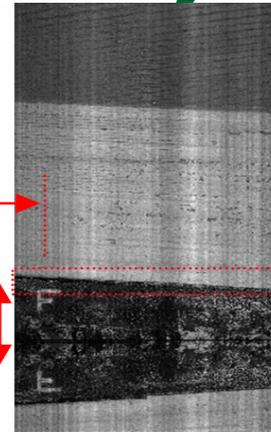
Runway 8L  
WE E2



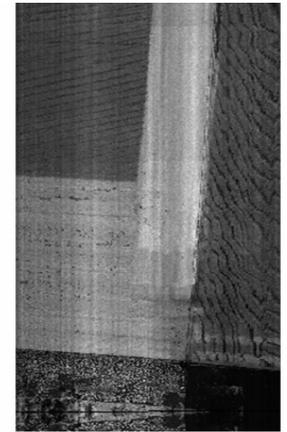
Runway 8L  
WE E3



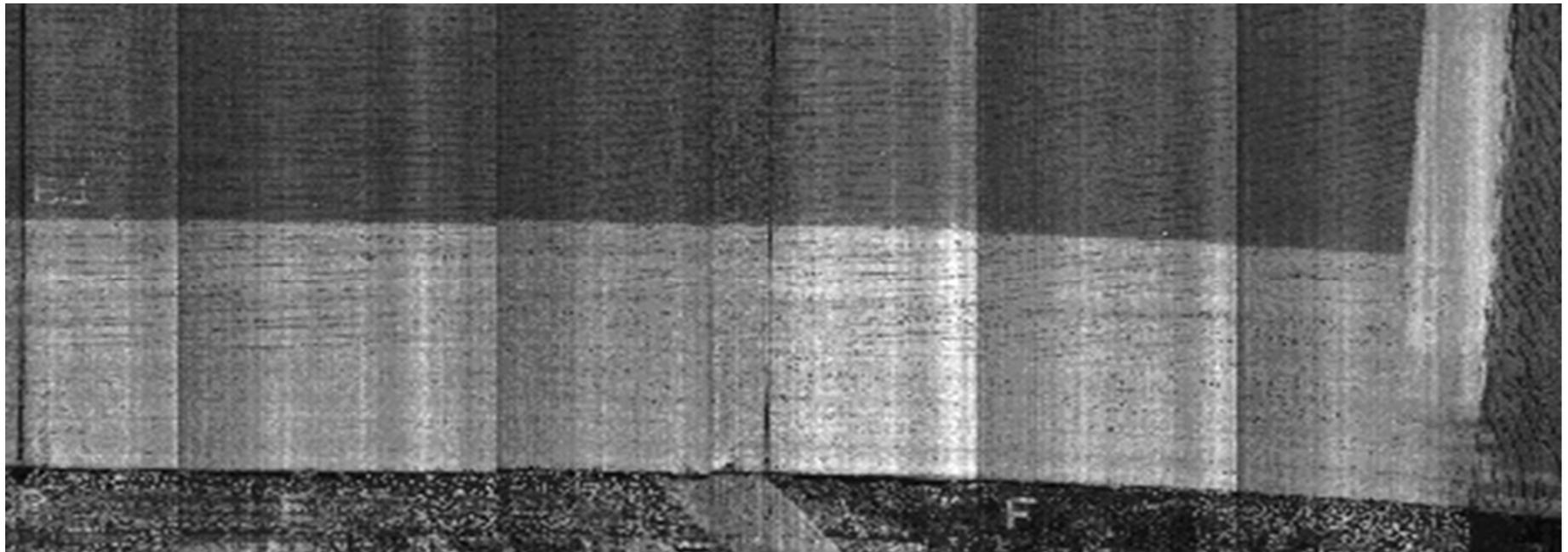
Runway 8L  
WE F1

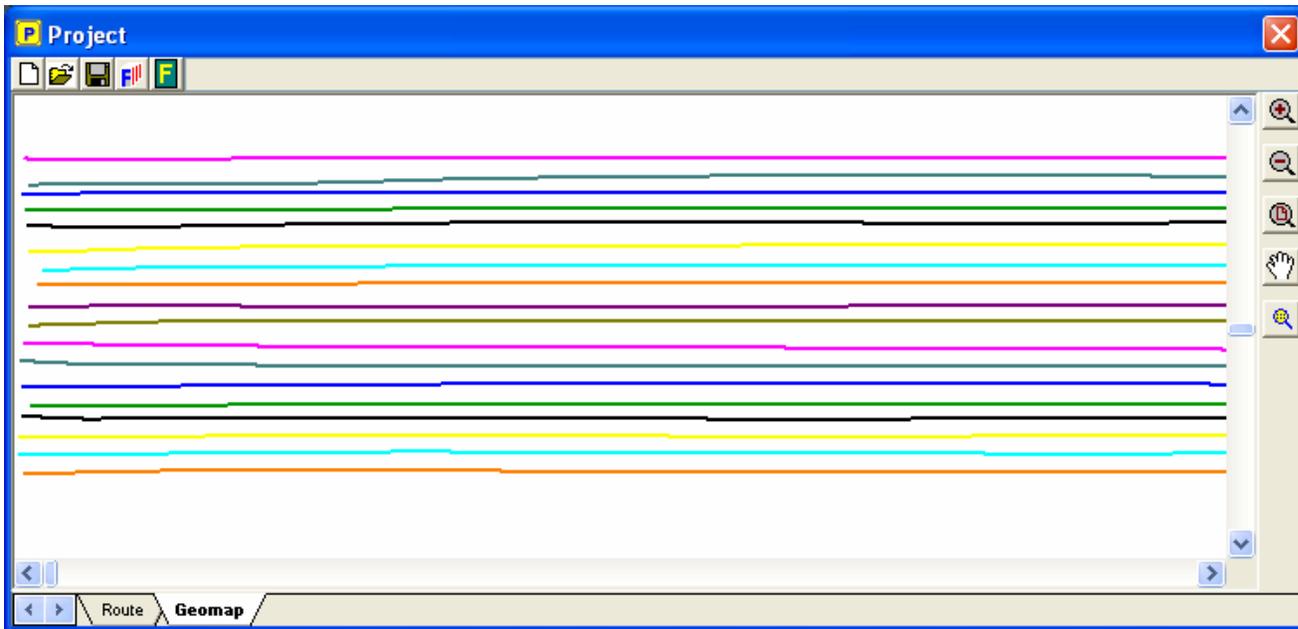
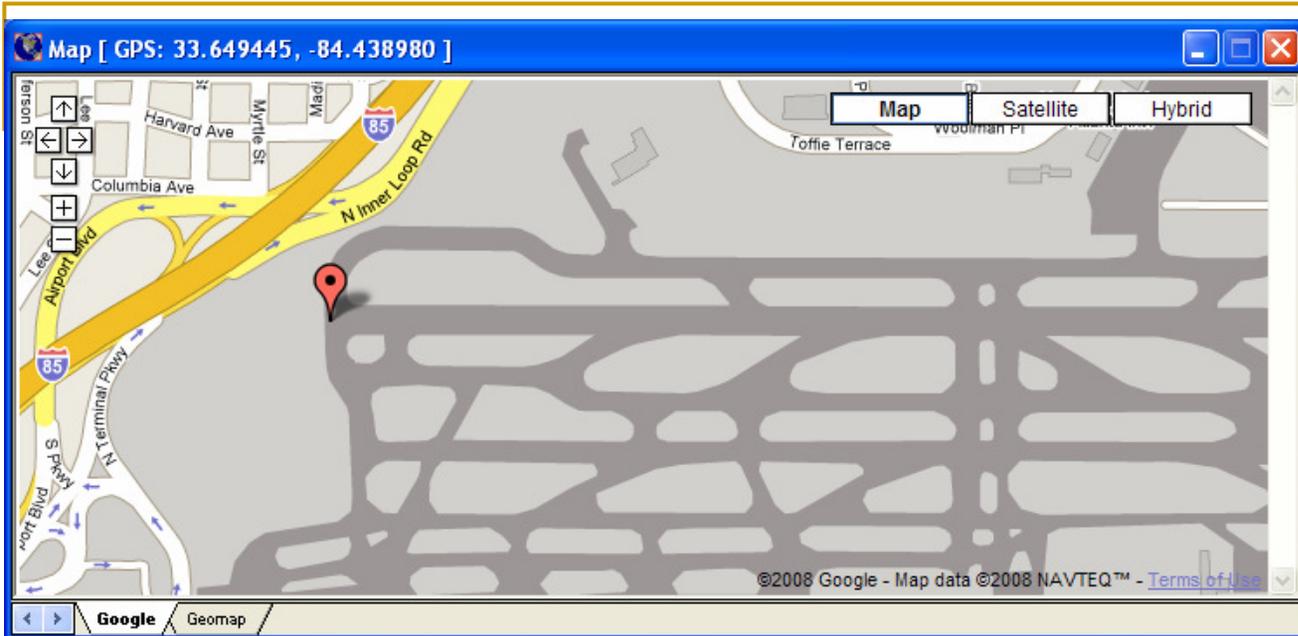


Runway 8L  
WE F2



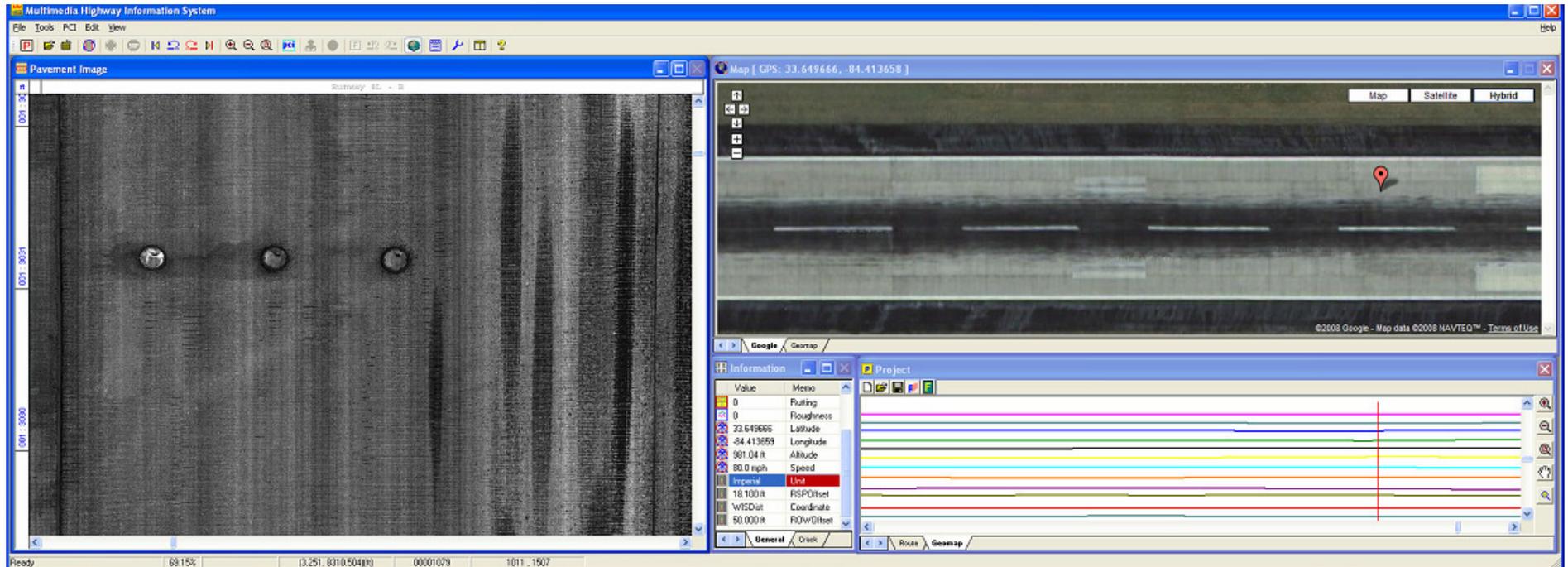
Runway 8L  
WE F3





Passes with  
GPS  
Coordinates  
from  
Multiple  
Data  
Collection  
Passes

# MHIS-Airport Software Interface



Based on the architecture of Multimedia based Highway Information System (MHIS), MHIS-Airport is designed and made specifically for airport pavement condition survey.

The screenshot displays a software application window titled "Multimedia Airport Information System". The main workspace shows a grid of 12 sample sections, each labeled with an ID (e.g., ID-9-0, ID-9-1, ID-10-0, ID-10-1, ID-11-0, ID-11-1, ID-12-0, ID-12-1, ID-13-0, ID-13-1, ID-14-0, ID-14-1, ID-15-0, ID-15-1, ID-16-0, ID-16-1). The sections are arranged in a 6x2 grid. A "City/Buffer" dialog box is open, showing a grid of points with columns for File#, File2, Date1, Date2, Row, Col, and Status. The "Map" window shows an aerial view of an airport with various runways and taxiways highlighted in yellow. The "Information" table at the bottom right contains the following data:

No.	TimeCode	RoadName	Length(m)	Folder
0	20070915 012115.250	ATL10-28 Taxi way NS A1	0.948	G-VATL-Asp
1	20070915 012212.843	ATL10-28 Taxi way NS A2	0.925	G-VATL-Asp
2	20070915 012338.625	ATL10-28 Taxi way NS A3	0.932	G-VATL-Asp
3	20070915 012435.238	ATL10-28 Taxi way NS B1	0.958	G-VATL-Asp
4	20070915 012547.265	ATL10-28 Taxi way NS B2	0.940	G-VATL-Asp
5	20070915 012652.312	ATL10-28 Taxi way NS B3	0.940	G-VATL-Asp
6	20070915 012759.156	ATL10-28 Taxi way NS C1	0.948	G-VATL-Asp
7	20070915 012902.671	ATL10-28 Taxi way NS C2	0.1117	G-VATL-Asp
8	20070915 013025.234	ATL10-28 Taxi way NS C3	0.955	G-VATL-Asp
9	20070915 013121.715	ATL10-28 Taxi way NS D1	0.963	G-VATL-Asp
10	20070915 013230.718	ATL10-28 Taxi way NS D2	0.966	G-VATL-Asp
11	20070915 013327.734	ATL10-28 Taxi way NS D3	0.948	G-VATL-Asp

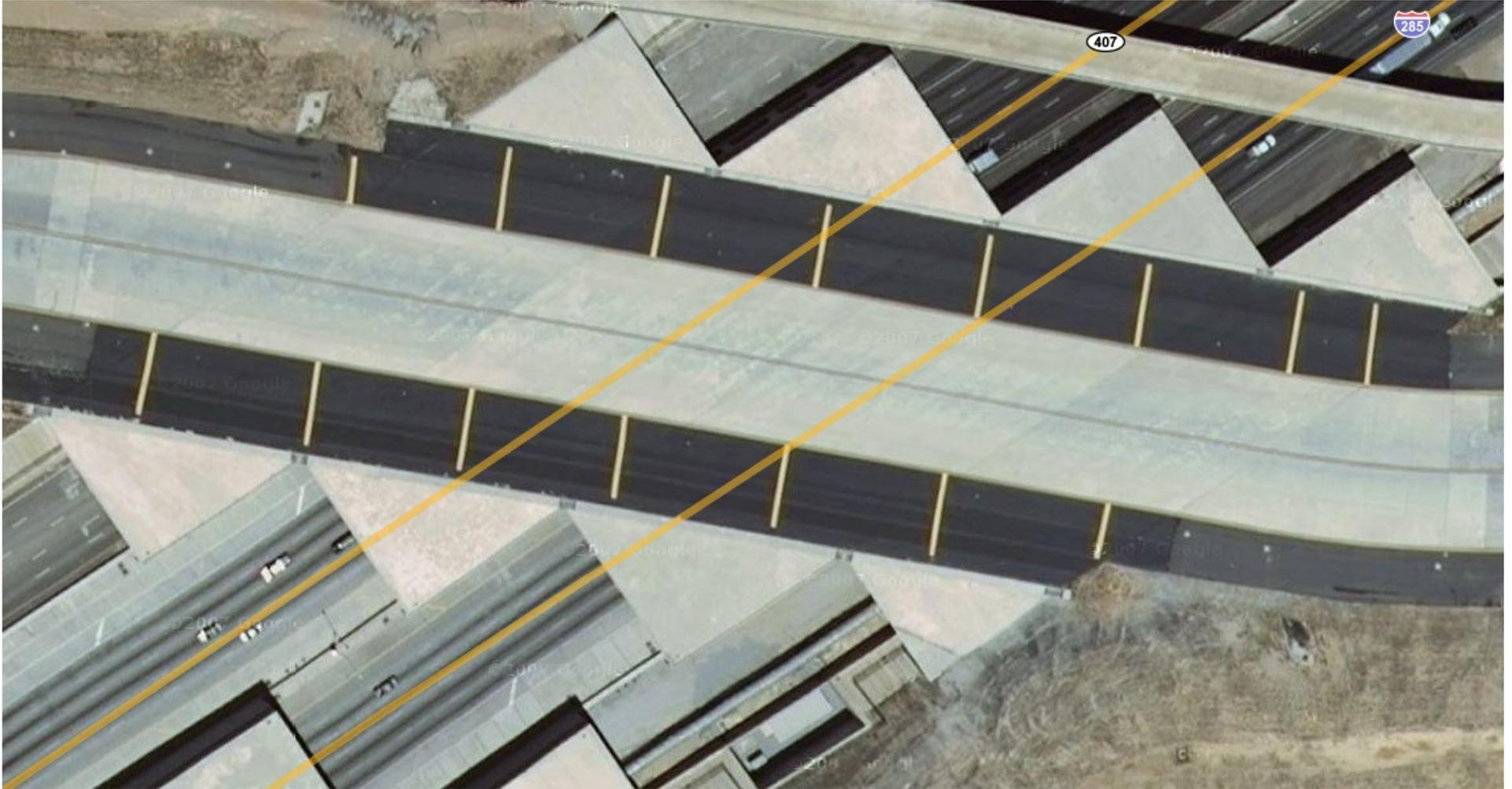
# PCI Surveys on Uniform Sample Sections

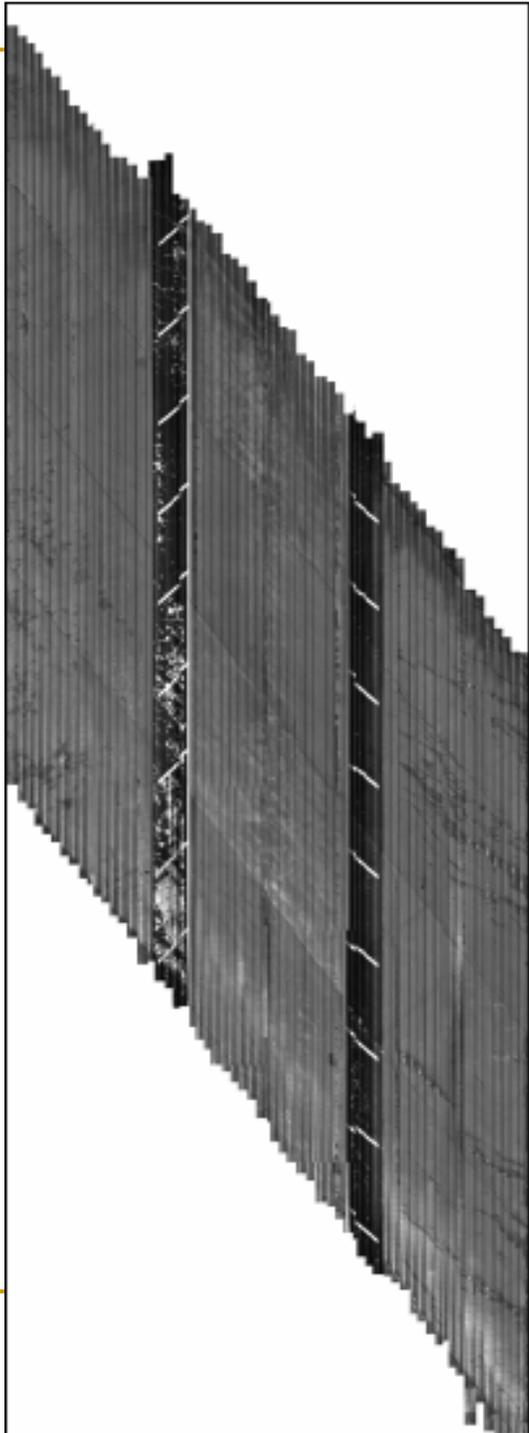
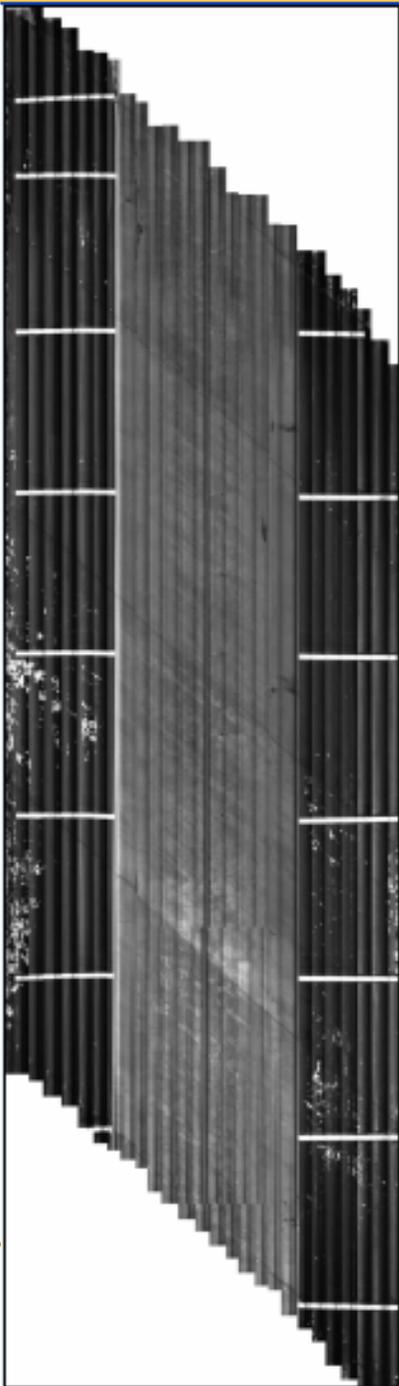
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# Runway Bridge Deck, ATL



# Taxiway Bridge Deck, ATL





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# Latest Developments

- 3D Solutions (New & In Progress)
    - With laser illumination, 3D cameras to capture x, y, & z dimensions of pavement surface
    - Resolution: 1-mm for x & y plane, 0.5-mm for z (vertical)
    - Potential to Automate PCI Surveys
  - Challenges and Opportunities
    - Software Development, Key to Full Automation
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# Conclusion

- Laser based Imaging
    - 1-mm Resolution (higher in the future)
    - Fully Implementable for Airport PCI Surveys
    - Data: Consistent, Repeatable, Retrievable
    - Good for Night Operation
  - 3D Development: Potential to Revolutionize Pavement Condition Survey
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**Thank You !**