

# Pavement Evaluation

## A Combined Technology Approach

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# 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

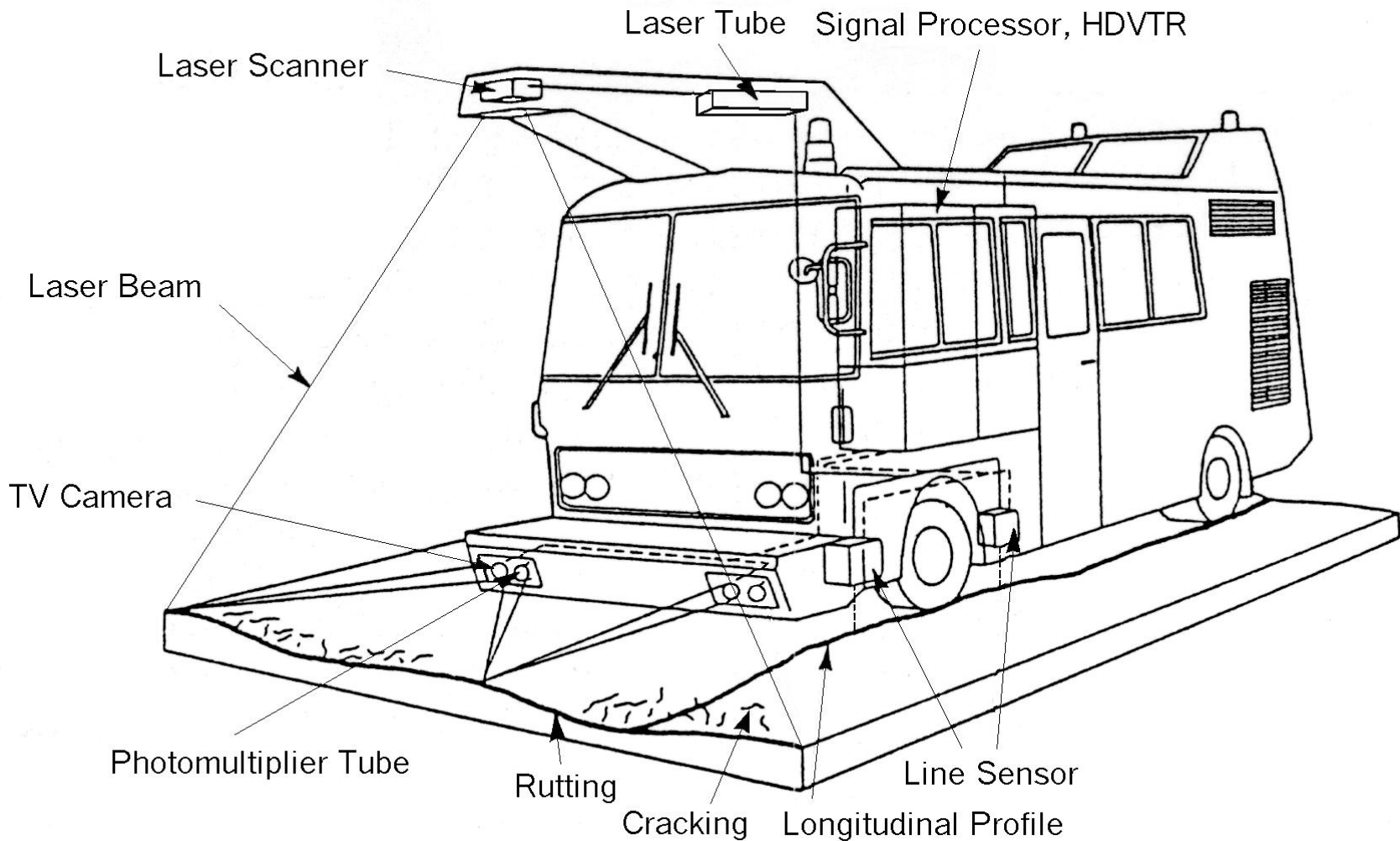


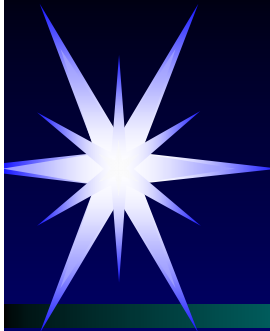
# RoadCrack, RTA & CSIRO



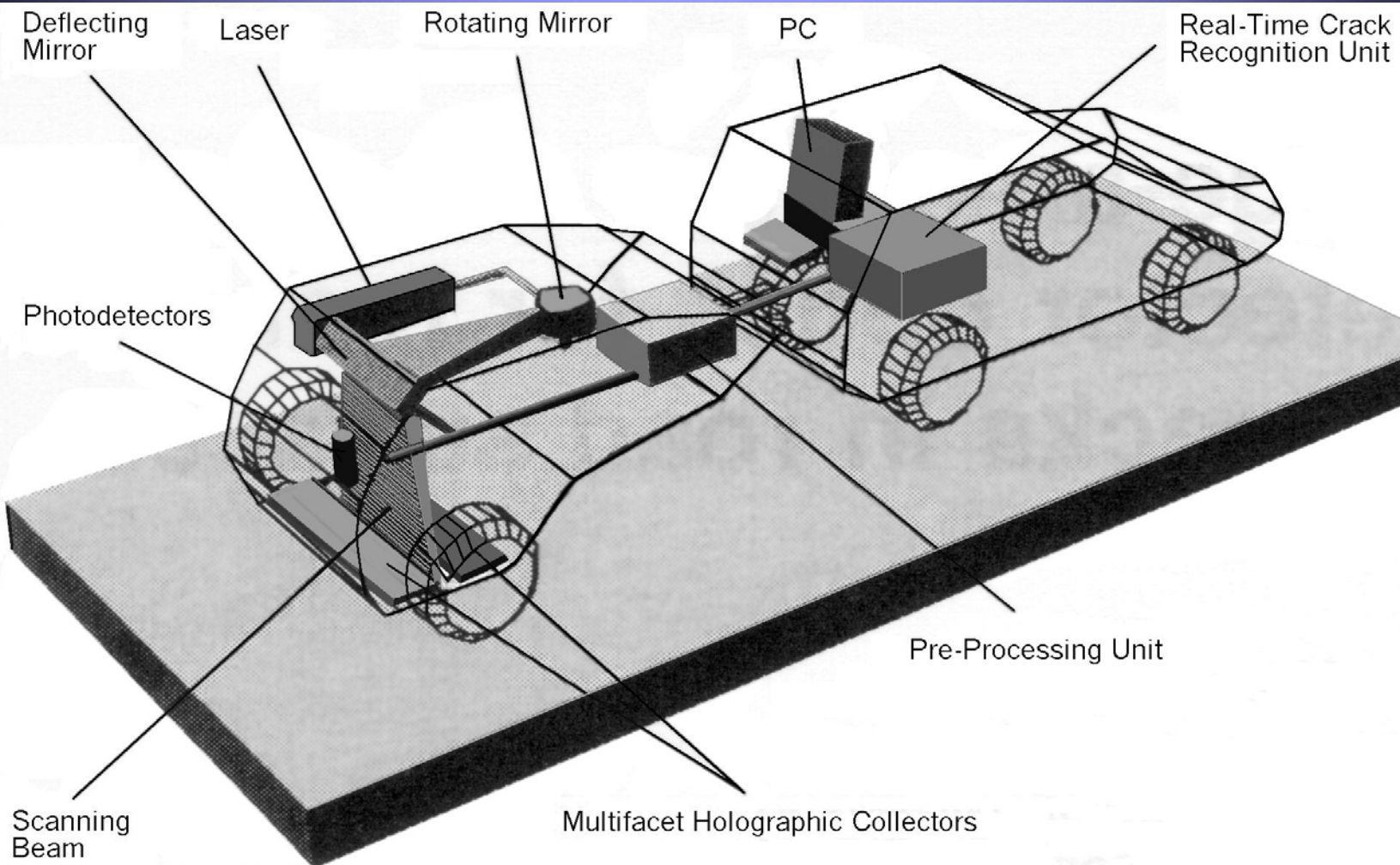
Southeastern States Pavement Management & Design Conference, May 7-10, 2006, Panama City, Florida 3

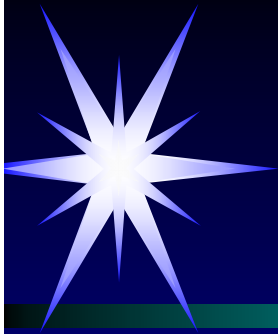
# Japanese Komatsu Survey Vehicle





# Swiss CREHOS System





# BIRIS Laser Technology, GIE Tech, Quebec, Canada



 3D Sensors

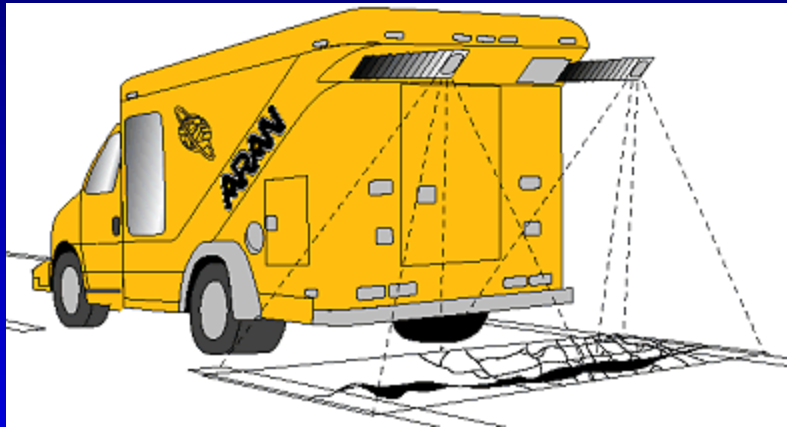




# INO Laser Rutting Measurement System (LRMS), Quebec, Canada

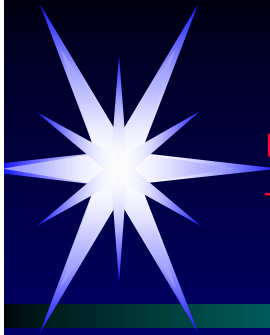


# ARAN of RoadWare



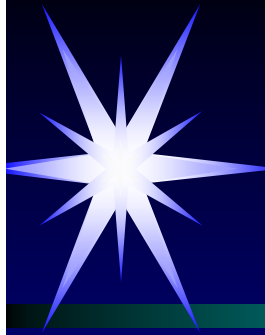
- Coverage: 4-Meter Width
- 2-mm Resolution
- Area-Scan Camera
- Strobe Lights
- Automation
  - Requires Manual Intervention





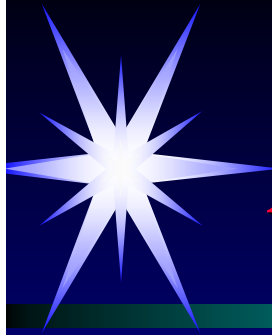
# Summary of Technologies Outside US

- RoadCrack of Australia
  - Full Automation of Cracking Survey with Limited Success (High Equipment Cost & Technical Limitations)
- HARRIS in UK
  - Largely Data Collection Only
- WiseCrack of RoadWare
  - Used in US and Other Places
- Limited Information on Japan



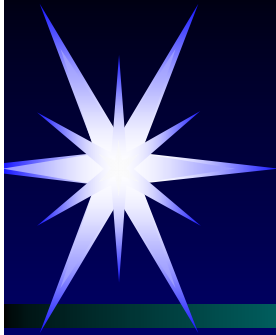
# US Based Technologies

- Commercially Available:
  - The Digital Highway Data Vehicle (DHDV), WayLink Systems Co.
- Phoenix Scientific, California
  - Rutting & Roughness, No Cracking Survey Yet
- Texas DOT
  - Automated Cracking
  - Internal Usage, Not for Commercialization
- Others



## Activities in US

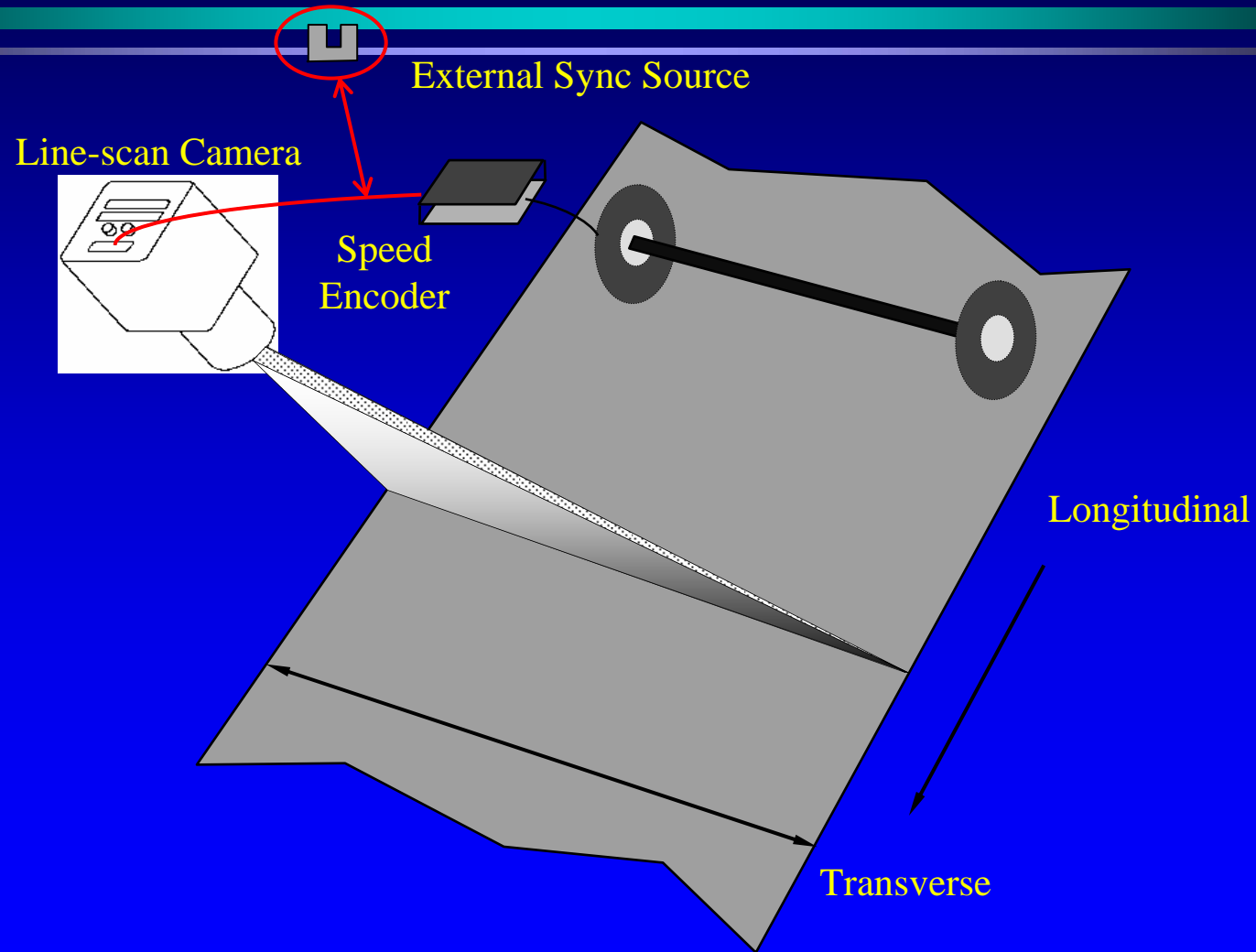
- LORAL, Now Lockheed-Martin in AZ
  - LTPP Support 10 Years Ago
  - Non-Active
- Other Smaller Scale University Efforts
  - Little Commercialization

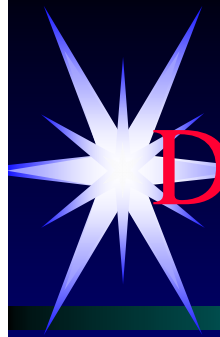


# DHDV

- Initial Research: Mid 1990's
- DHDV: Vehicle Purchase in 1998
- Full Digital Van: 1999, Area Scan Technology
- DHDV: 2004, Line Scan Technology
- DHDV: 2005, New Vehicle Chassis
- Now: Laser based Illumination for Line Camera

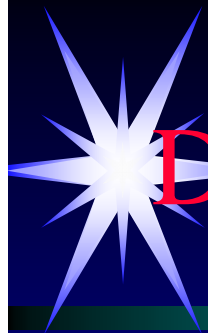
# Line Scanning Method





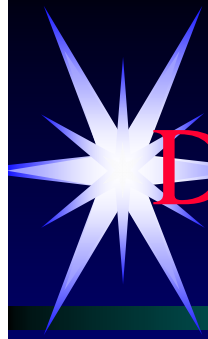
# Digital Highway Data Vehicle, DHDV





# Digital Highway Data Vehicle, DHDV

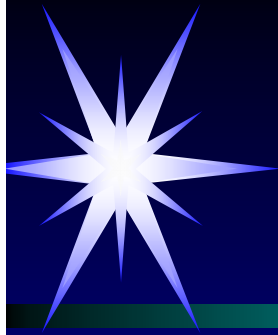




# Digital Highway Data Vehicle, DHDV

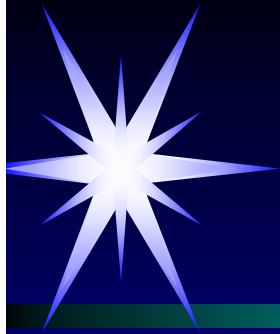






# DHDV: Multi-Function

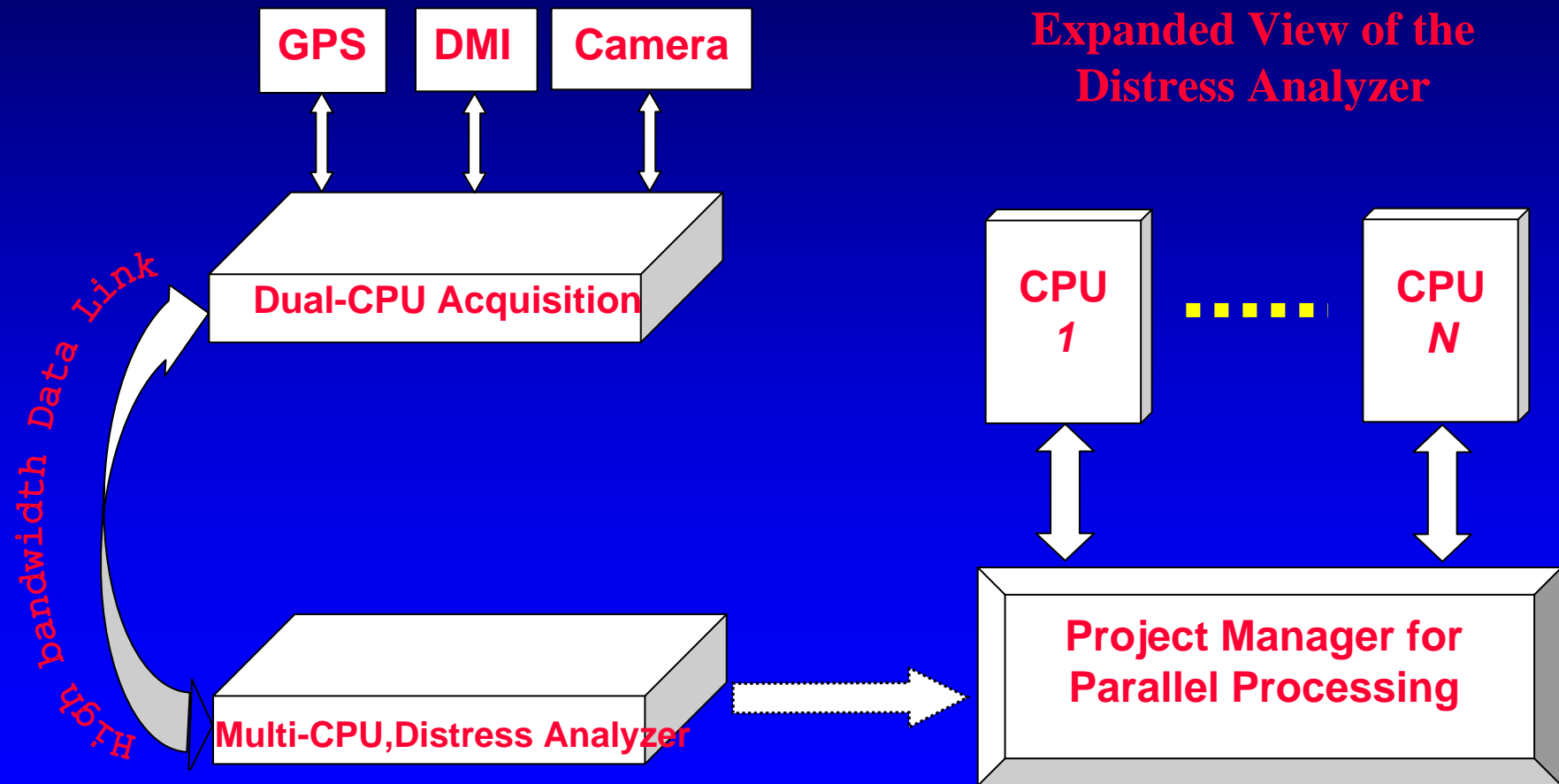
- Automated Cracking Survey
- Longitudinal Profile, Roughness, IRI
- Rutting, 1200 Points
- Macro-Texture
- Right-of-Way Images
- GPS Receiver, DMI, Gyro



# Automated Cracking Survey, DHDV

- Resolution, 1-mm
- Coverage, 4-Meter Width, Complete
- Automation, Full
- Speed
  - 100 kilometer per hour, Data Collection and Automated Processing
- Indices
  - AASHTO, World Bank, Partial LTTP

# The Parallel Computing Approach





# Parallel Distress Analyzer

WISAnalyzer(1) | WISAnalyzer(2)

File Option View Tool Window Help | File Option View Tool Window Help

Fit BkColor Prev Next | Fit BkColor Prev Next

Type	BoundBox	Area	Dir	Location	Width
1	LONGITUD 173(w)*1229(h)	8800	90	855(l) 1033(r) 13(l) 1241(r)	3.77
2	LONGITUD 32(w)*811(h)	5568	90	95(l) 126(r) 289(l) 1099(r)	6.24

Type	BoundBox	Area	Dir	Location	Width
3	TRANSVE 760(w)*102(h)	5121	0	95(l) 854(r) 1120(l) 1221(r)	5.54
4	LONGITUD 66(w)*639(h)	3716	90	232(l) 257(r) 13(l) 651(b)	4.17
5	LONGITUD 43(w)*415(h)	2338	90	707(l) 749(r) 725(l) 1139(r)	4.87

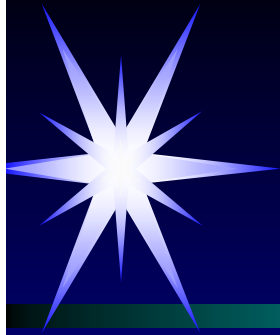
Type	BoundBox	Area	Dir	Location	Width
1	LONGITUD 273(w)*1236(h)	14903	90	97(l) 369(r) 12(l) 1247(b)	9.28
2	LONGITUD 67(w)*1148(h)	11326	90	1180(l) 1246(r) 100(l) 12(r)	9.34

Type	BoundBox	Area	Dir	Location	Width
3	TRANSVE 83(w)*63(h)	489	0	821(l) 903(r) 12(l) 74(b)	3.94
4					
5					

64.4% | ImgNo:511 | Speed 14.0 mph | Latitude 36.05463000 | Longitude -94.19118800 | Dmi 0.53812724 | pixel 0.0

0.3% | ImgNo:1 | Speed 26.5 mph | Latitude 36.04854100 | Longitude -94.17188700 | Dmi 0.00298153 | pixel 0.0(s) | Hide

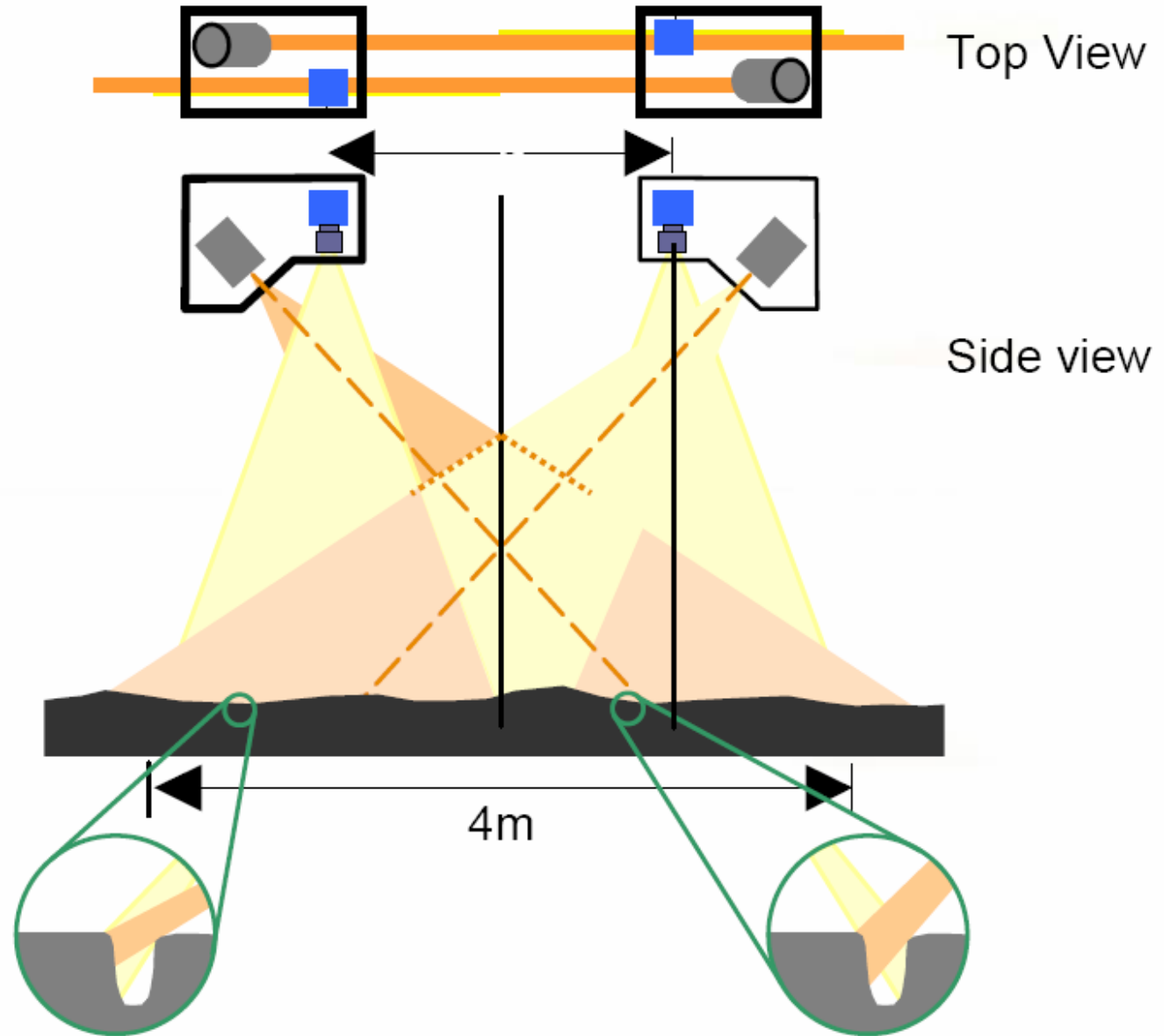
Project Manager | No Data | No File N | 7 T:\Inn | 8 T:\Inn | 9 T:\Inn | 10 T:\Inn | 11 T:\Inn | 12 T:\Inn | 13 T:\Inn | 14 T:\Inn | 15 T:\Inn | 16 T:\Inn | 17 T:\Inn | 18 T:\Inn | 19 T:\Inn | 20 T:\Inn | 21 T:\Inn

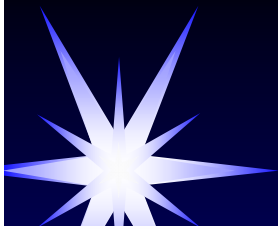


## New Laser based Illumination

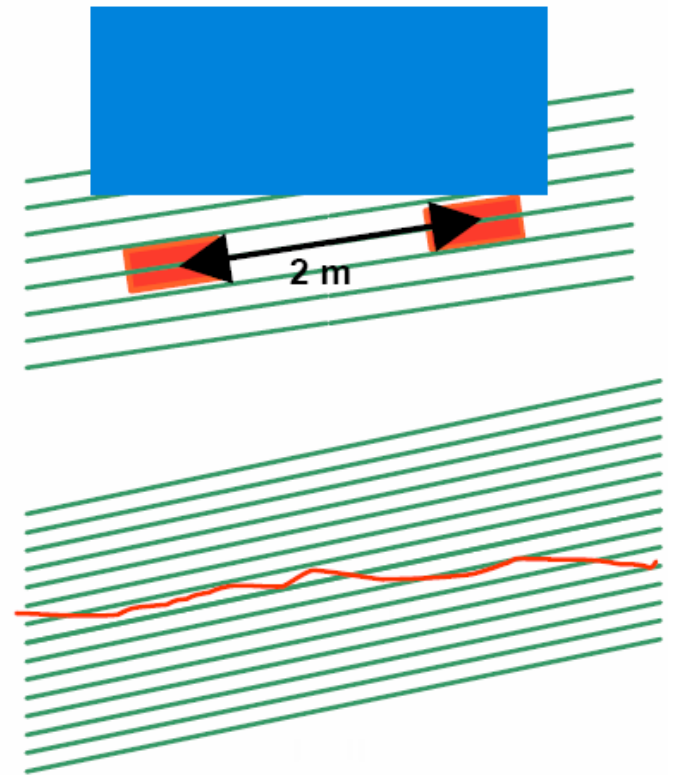
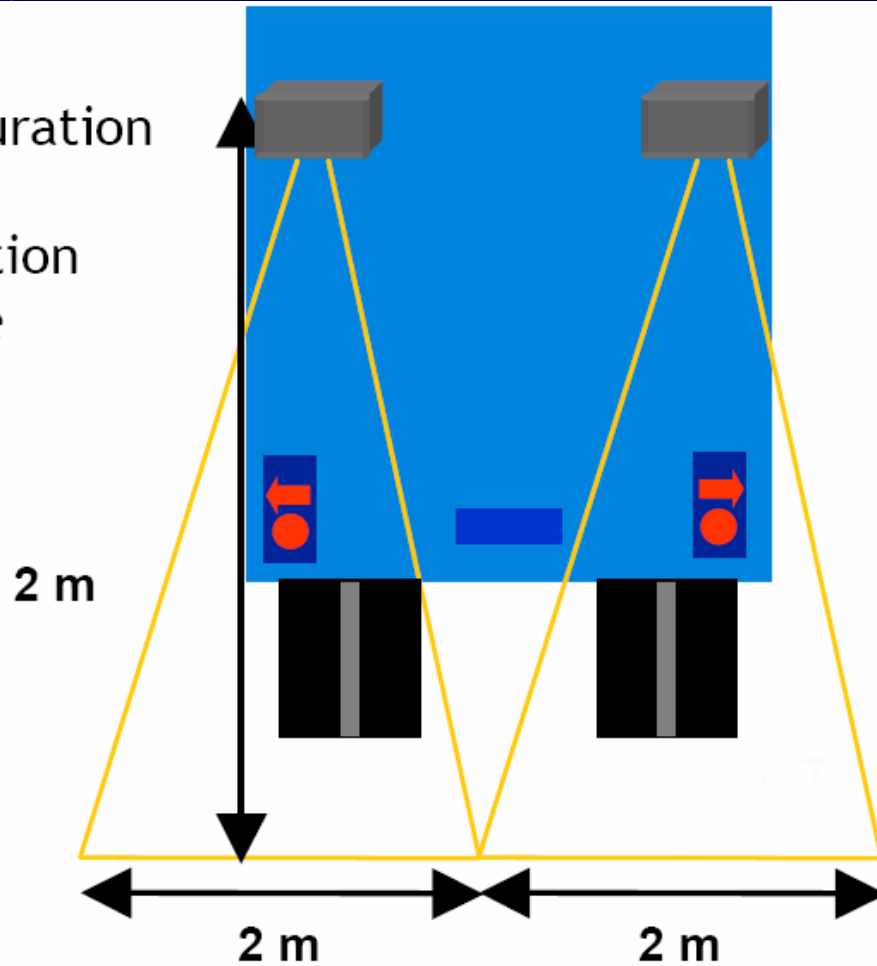
- Same 1-mm Resolution
- Complete Pavement Coverage, 4-meter Wide
- Any Weather Condition as long as Dry Pavement
- No Shadow in Lighting Condition
- Uniform Image Quality

Incident angle of the illumination system allows increased visibility of small cracks by the use of the projection of shadows





System configuration on an inspection vehicle

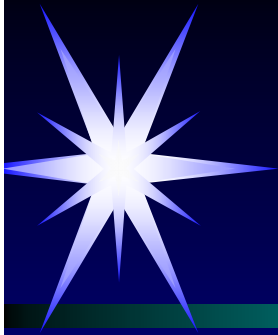


Small tilt angle to help contrast transverse cracks



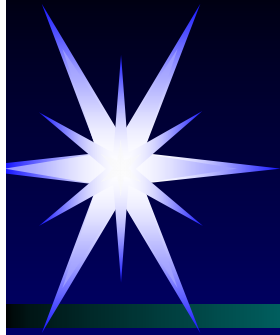






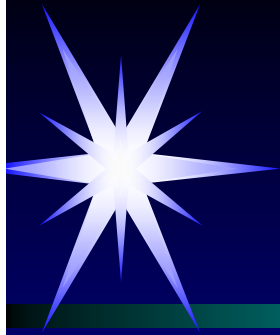
# DHDV Implementation of LRIS

- January 2006: Installation
- No more generator
- No more lights
- 1st DHDV with LRIS
  - Being Completed
- 2<sup>nd</sup> DHDV with LRIS: in Progress



# Demonstrations

- Automated Distress Analyzer (ADA)



# Conclusion

- Standardized Sensor Platforms
  - Profiling (IRI), Rutting, Pavement Imaging
- Future Market Place
  - Algorithms and Software
  - Certification
  - Further Integration of Multi-Function
  - More Automation