3D Laser Imaging at Highway Speed

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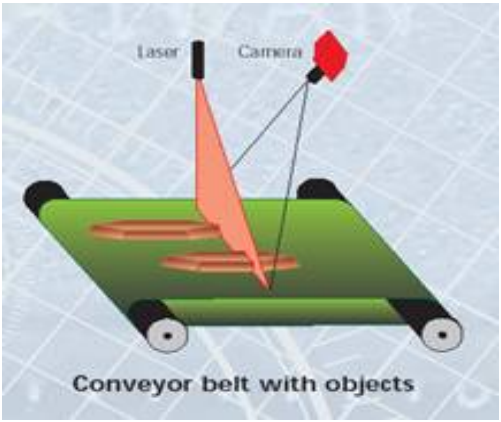
Presentation at the 2012 National Concrete Consortium Meeting

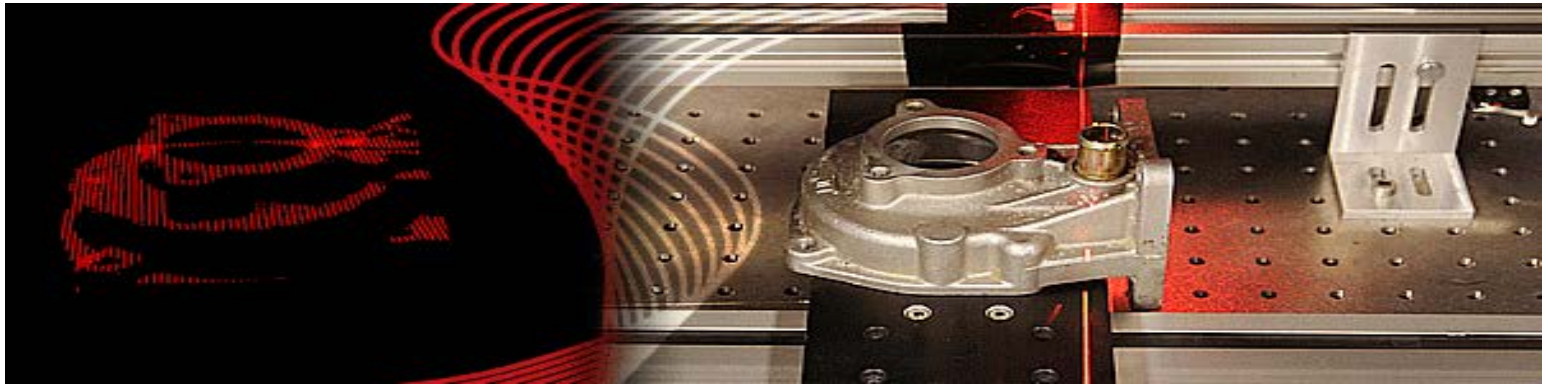
Oklahoma City Sheraton Hotel

3D Laser Imaging for Pavements

- Mature Technology in Other Industries
  - Indoor and Controlled Environment
- Paradigm Shift for Pavement Engineering
  - Potential to Cover Most if Not All Data Collection on Pavement Surface
- How to Obtain True 1mm 3D Visual Data at Highway Speed?
- How to Provide Multiple Solutions in One Pass that Meet Expectations?

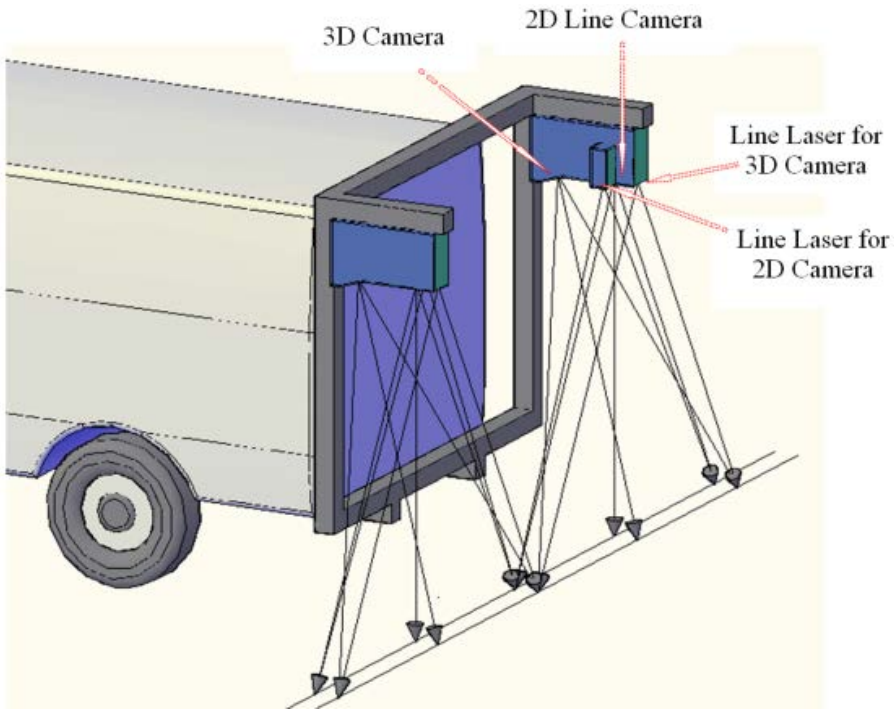
Laser Line based 3D Imaging Technique on a Conveyer Belt





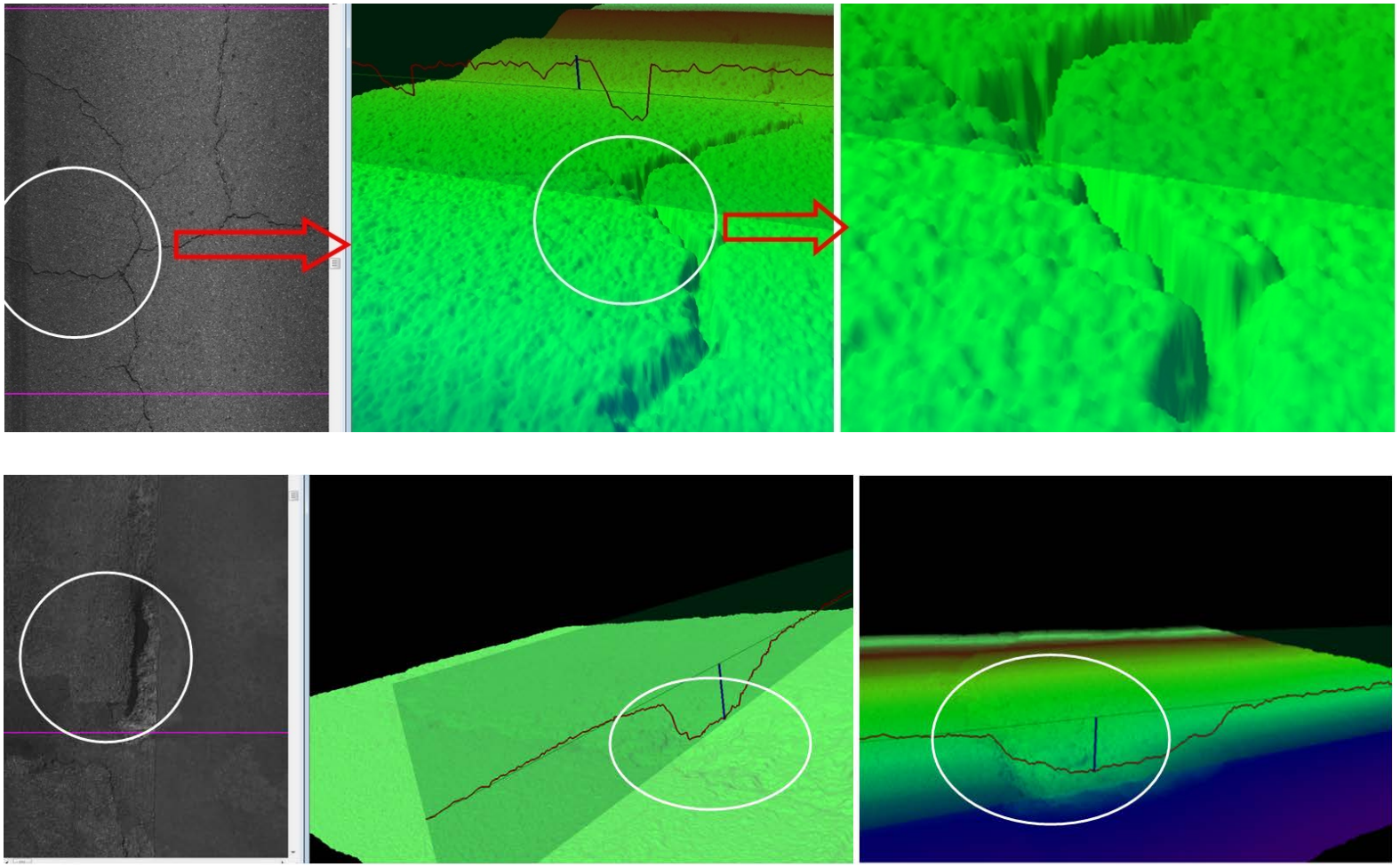
http://www.adept.net.au/news/newsletter/200810-oct/3D_Camera.shtml

Sensor Design & Prototyping 2009-2010



Sensor Illustrations

Collected 3D Sample Images with the Prototyping System



A Major Limitation

- Operating 3D Profile Line Rate
  - From 4000 to 6000/second
  - About 4mm to 6mm Resolution in the Longitudinal Direction
    - Or ¼-inch Resolution in Long
  - Theoretical Line Rate:>10k
    - Not Achievable in the Field

Research Approach

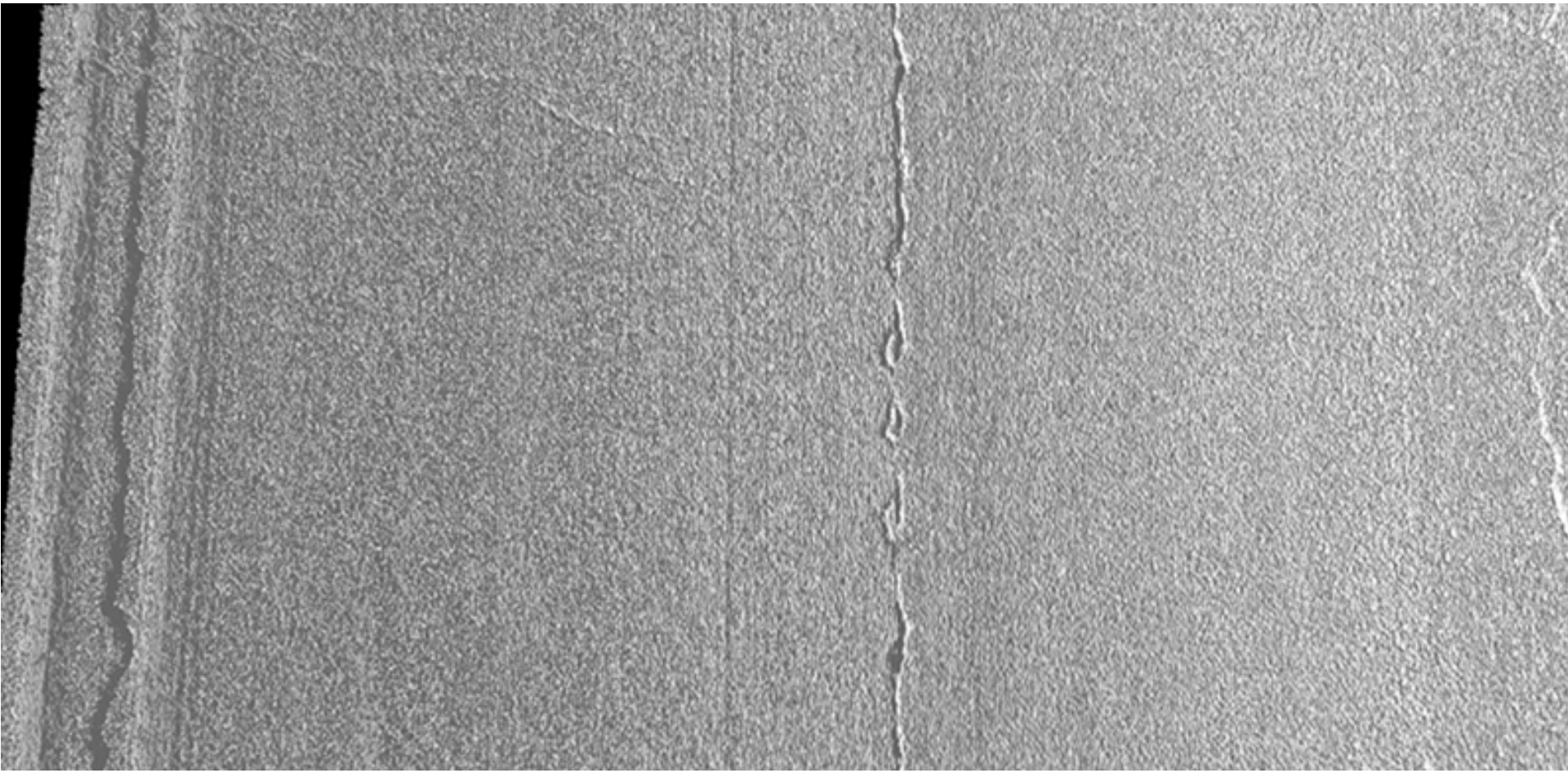
- Use Multiple Sensors
- Increase 3D Profile Line Rate to 28,000/second
- Complete Coverage of Pavement Lane
  - True 1mm at Any Data Collection Speed up to 60MPH

Field Trials and Challenges

- Single Computer
- Data Rate for 3D Only
  - 4000x2x28000=224,000,000 bytes, 224 MB/sec before compression
  - Continuous for a few hours non-stop
- Advantage
  - Low Power < 1000 watts in all
  - Complete Coverage at True 1mm

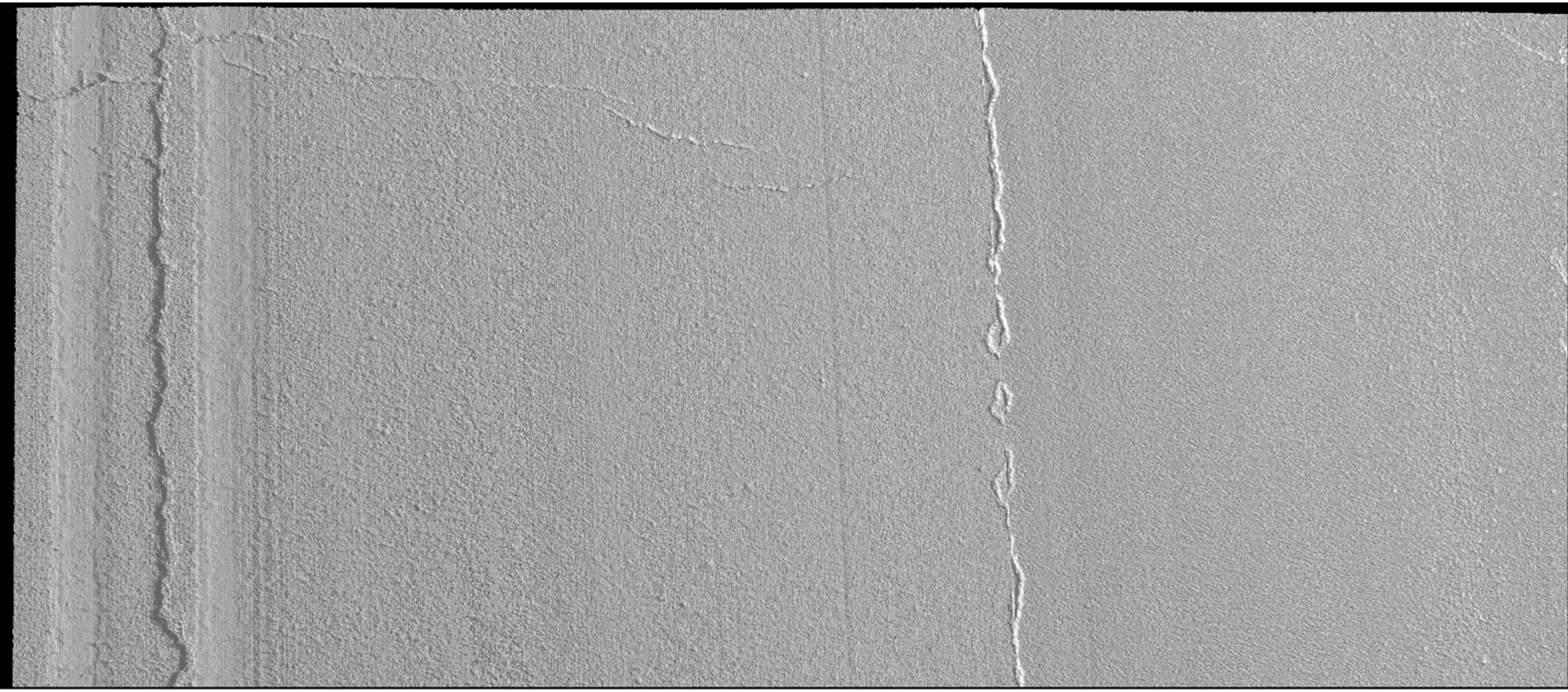
Comparison on the Same Pavement

- 7000 3D Profiles/Sec



Comparison on the Same Pavement

- 28,000 3D Profiles/Sec

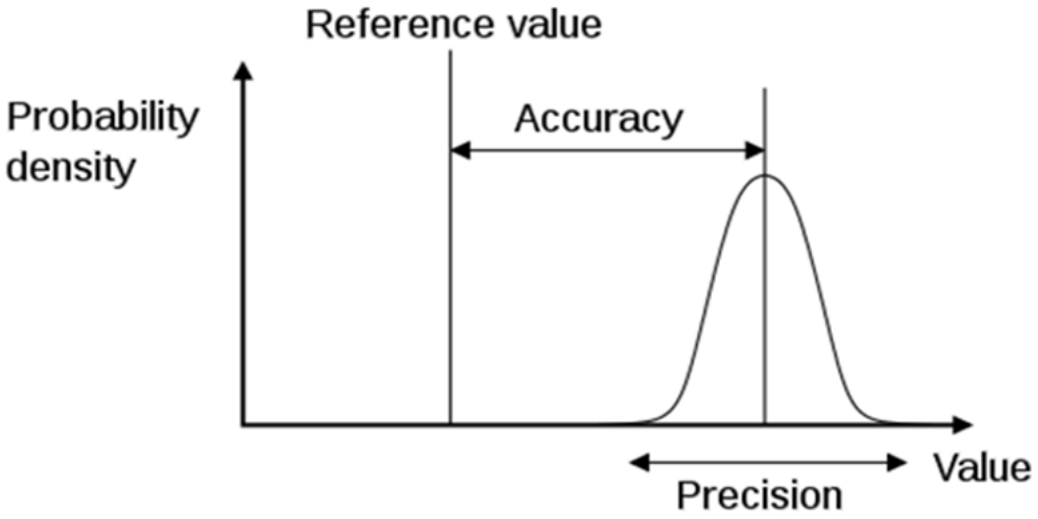


Potentials

- All Surface Distress Survey
  - Flexible and Rigid
  - Complete Automation? Few More Years
- Safety Analysis
  - Macro-Texture
  - Friction (long-shot, possible correlation)
  - Geometry
- Roughness

Demo Video

Precision & Bias Concept



Good accuracy, Low precision

High precision, Low accuracy

- Variability: Unevenness, Changeability
- Precision and Accuracy
- Reference Value and Probability

Conclusions

- Direct Impact
  - Pavement Management
  - Pavement Design (DARWin-ME)
- Pavement Surface Safety
- Clearer Potential than Ever
- Software Solutions & Long-Term Research