Model-based Non-destructive Corrosion Detection

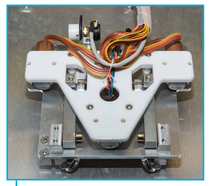
High detection probability and low false-call rate without disrupting workflow

- **Discriminating algorithms for unambiguous identification**
- **Safe in-situ/standoff operation on ferro-magnetic pipes**
  - Utilities
  - Refineries
  - District energy
  - Chemical facilities
- **Infrastructure in operation during testing**
- **Passive sensing**
- **Low power needs**
- **Leverages $12M prior investment**

Current NDT **vs** Draper's Solution

Magnetometry Based Technologies	Advantages of Draper's Technology
Measures stress anomalies; cannot distinguish defects from other causes	Identifies unique metal-loss signature from physics-based missing metal defect model
Low probability of detection (POD), high false-call rate (FCR)	High defect sensitivity and false-call rejection
Poor defect localization accuracy	Defect size information and noise rejection using large numbers of sensor gradients

Moving System Scans Large Pipe Sections Quickly and Noninvasively


Test Fixture


Support Electronics

Future Improvements

- Increase standoff
- Expand types of defects detected
  - Corrosion under insulation
- Develop roll-on pipe system

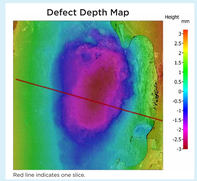
Proven Companion Technology

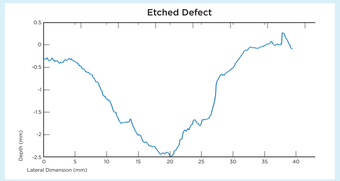
Static Detection — WiSense

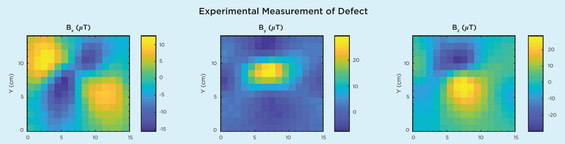
- Passive measurement of pipe's magnetic field
- Dense array of **low-cost magnetic sensors**
- Track localized changes in a pipeline's integrity

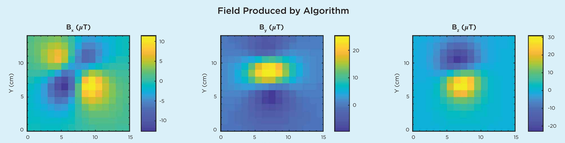
Demonstrated Model Effectiveness

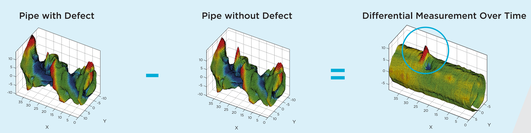
- X42, X52 pipes tested in both lab and field
- Data from multiple 3D sensor gradients
- Algorithm correctly identified location of defects











Other District Energy Projects

In-situ Smart Energy Storage Architecture

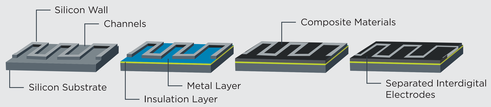
Maximize solar system efficiency by storing excess energy in the cell

Advantages

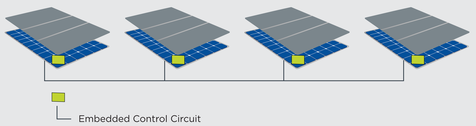
- Individual cell performance does not limit system performance
- Energy available from solar cells for 24 hours
- Reduce need for battery banks

Enabling Technologies

Improve system manufacturing with thin-film grown micro-supercapacitors



Increase panel efficiency with low-power embedded smart control electronics

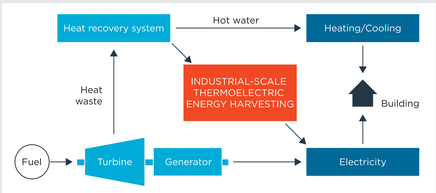


Advanced Thermoelectrics

Extracting the next level of energy from excess heat

More than half of the energy generated in the U.S. is lost as waste heat, but today's thermoelectrics remain too expensive and too inefficient for large scale energy harvesting. Redesigning thermoelectrics enables a future of scalable, affordable energy harvesting.

Draper's Approach: Better Materials Designed for Scalable Production



Advantages

- Higher efficiency materials
- Scalable production
- Reduced mechanical stresses
- Industrial-scale thermoelectric applications

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