Northeast GAS ASSOCIATION

NYSEARCH

ILI Capabilities/Application Research Updates NYSEARCH

US DoT Government & Industry Pipeline R&D Forum
Working Group #4
Expanding In-Line Inspection Capabilities & Application
Baltimore, MD – September 11, 2018

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NYSEARCH/Northeast Gas Association

Overall Goals

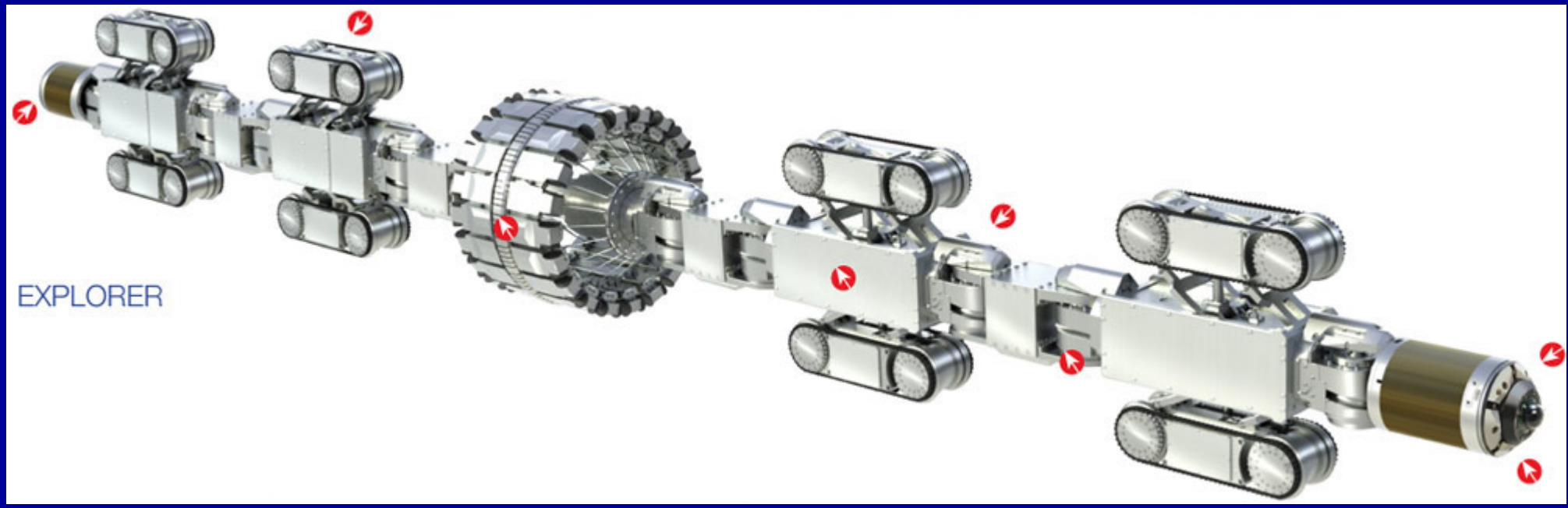
- Focus of our effort is the inspection of UNPIGGABLE natural gas pipelines
  - Develop family of robotic platforms to deploy sensory technology in unpiggable pipelines
  - Develop technologies for anomaly detection and characterization (crossing over to piggables) and material characterization
- Funding by NYSEARCH, DoT/PHMSA, OTD, Invodane, SDTC, DoE
- Developed by Invodane, CMU, Automatika, SwRI
- Commercialized by Pipetel

Priorities

- Present Priorities:
  - Operational efficiencies; mainly range
  - Crack detection
  - Material characterization
- Emerging Priorities:
  - Operational efficiencies (always important)
  - Semi-Autonomous systems (working towards Autonomous)
  - Defect detection and characterization in “difficult” areas (bends, casings)
  - Plastic pipe and joints in-situ inspection

Explorer Platforms

- Explorer 6
- Explorer 10/14
- Explorer 20/26
- Explorer 8
- Explorer 16/18
- Explorer 30/36



Platforms (cont'd)

- Launched and retrieved under live conditions via off-the-shelve fitting
- Bi-directional
- Able to negotiate most pipeline features; short-radius bends, mitered bends, vertical segments, back-to-back bends, plug valves (≥20" pipelines)
- Battery-powered
- Tether less (wireless communication)
- Range limited by batteries and wireless

Platforms (cont'd)

- Over the last 7 years we have had
  - More than 350 inspections
  - Longest inspection 8.5 miles
  - Longest river crossing 1,200 ft
  - Highest vertical drop 30 ft
  - Minimum pipeline pressure 0 psig
  - Maximum pipeline pressure 750 psig

Sensors

- RFEC sensor for 1G X6 & 8
- Axial MFL for X6, X8, X10/14, X16/18, X20/26 & X30/36
- Crack sensors
  - Global TMFL/EMAT for X20/26
  - Global EC for X8
  - Seam-weld TMFL/EMAT sensor for X20/26
- Optical Mechanical Damage sensor for X6, X8, X10/14, X16/18, X20/26 & X30/36
- Axial MFL sensor for bends inspection for X20/26
- Hardness tester for materials characterization for X20/26

Axial MFL Sensor

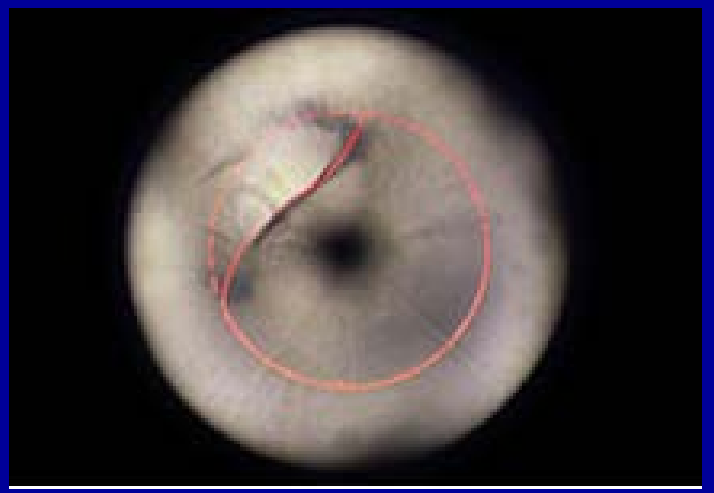
- Launched, operated and retrieved under live conditions; one pass inspection
- Able to negotiate short radius bends, mitered bends, vertical/inclined segments, plug valves (X20/26 and X30/36)
- Shunting of magnets for feature negotiation
- Bi-directional operation

Axial MFL Sensor (continued)

- Detection capabilities as other state of the art axial MFL tools
- Commercially available through Pipetel on X8, X10/14, X16/18, X20/26 and X30/36
  - X6 to be available in mid- 2019

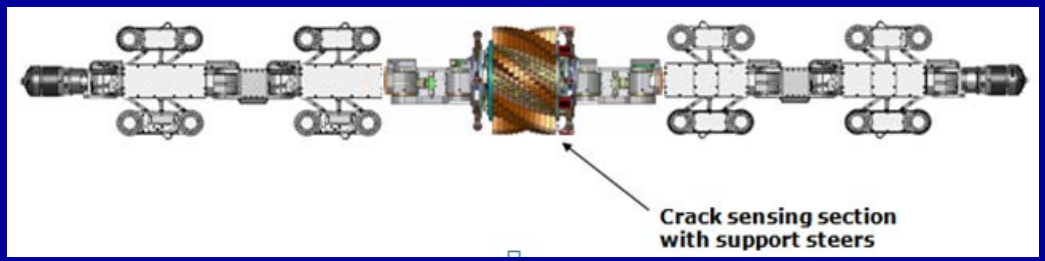
LDS Mechanical Damage Sensor

- Laser based system for detection of dents and ovality
  - Laser system on camera module illuminates the pipe
  - High resolution camera(s) on modified camera module provide the imaging
  - Full 3-D resolution of dents at 25 frames/sec
- Continuous interrogation of pipeline circumference
- Commercially available on all Explorer robots



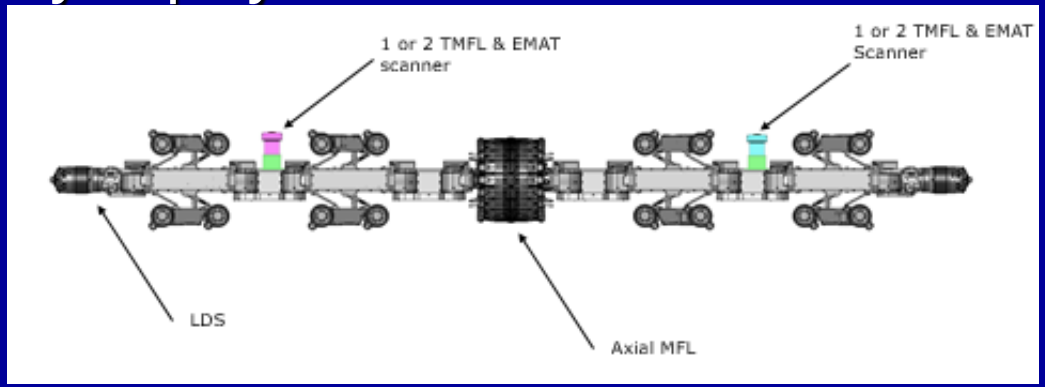
Crack Sensors

- Two different approaches
  - Full pipe and seam weld inspection; separate run from the axial tool
    - TMFL/EMAT sensor; reliable but big and heavy with high power requirements



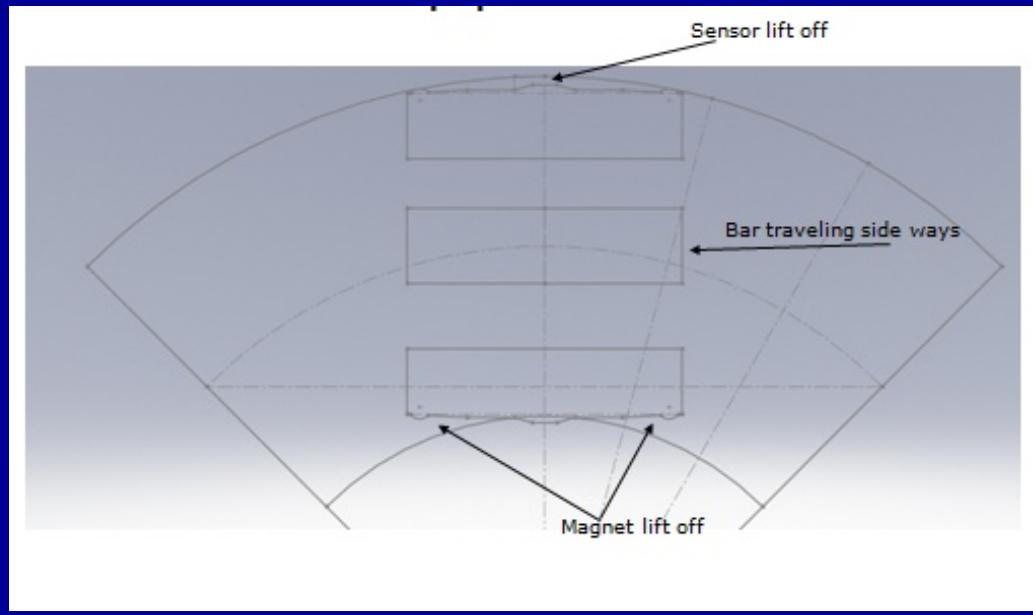
    - AMR EC sensor; not-as reliable but light and low power requirements

  - Seam weld inspection only; in one run with the axial MFL tool; to be commercially deployed in 2019



Bends Inspection

- MFL sensors have inherent limitations in inspecting of bends due to physical constraints
- Modified MFL sensor design so it can provide higher accuracy and detectability
- Commercially available on X20/26 and X30/36; to be commercially available in other Explorer robots over the next few years.

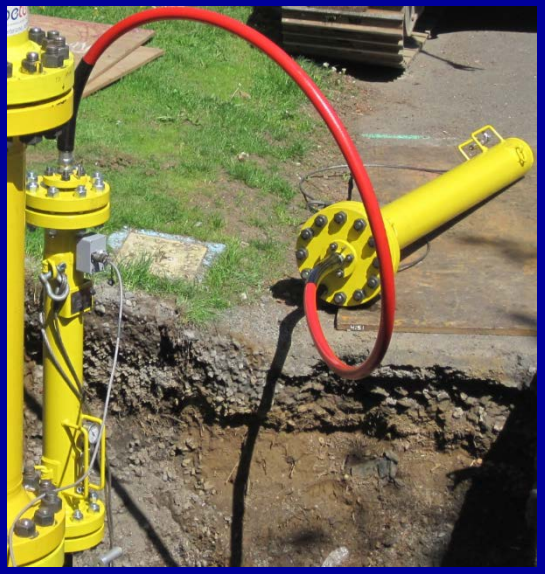


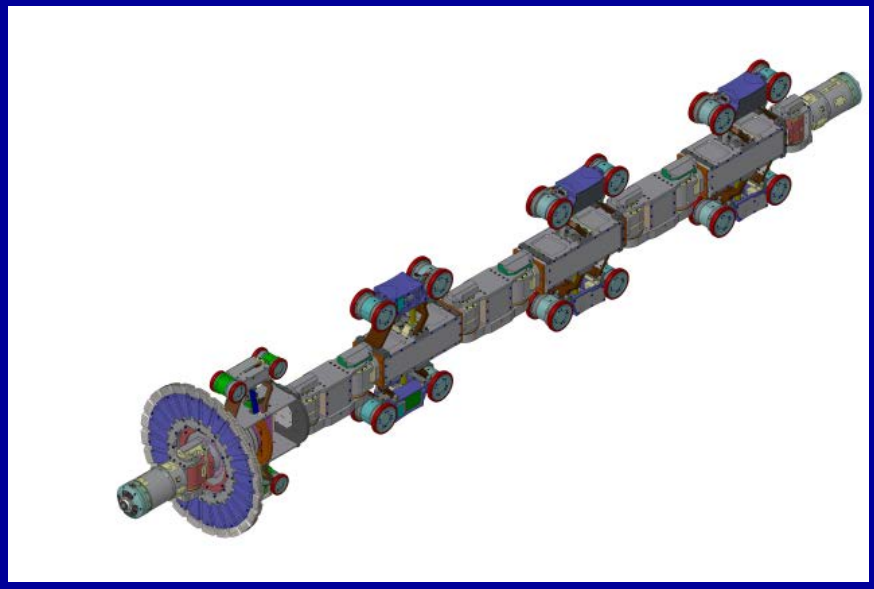
Hardness Tester for Materials Characterization

- Developed a hardness testing sensor module to allow materials characterization of pipelines under live conditions
  - Based on Rockwell B protocol
  - Meet standards for portable devices
- Separate run from axial MFL
- To be commercially available in mid- 2019

Technologies for Enhancing Explorer Operations

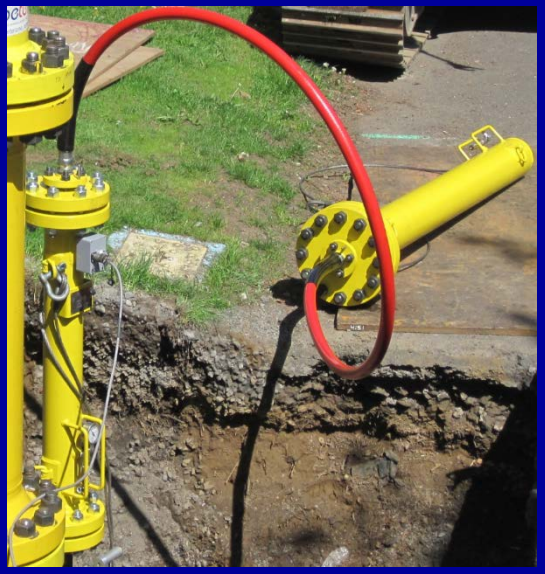
- In-line battery recharging
  - Implemented in all Explorer robots
- Unpiggable pipeline cleaning tool
  - Able to remove heavy debris and some liquids in unpiggable pipelines
  - Available on X20/26

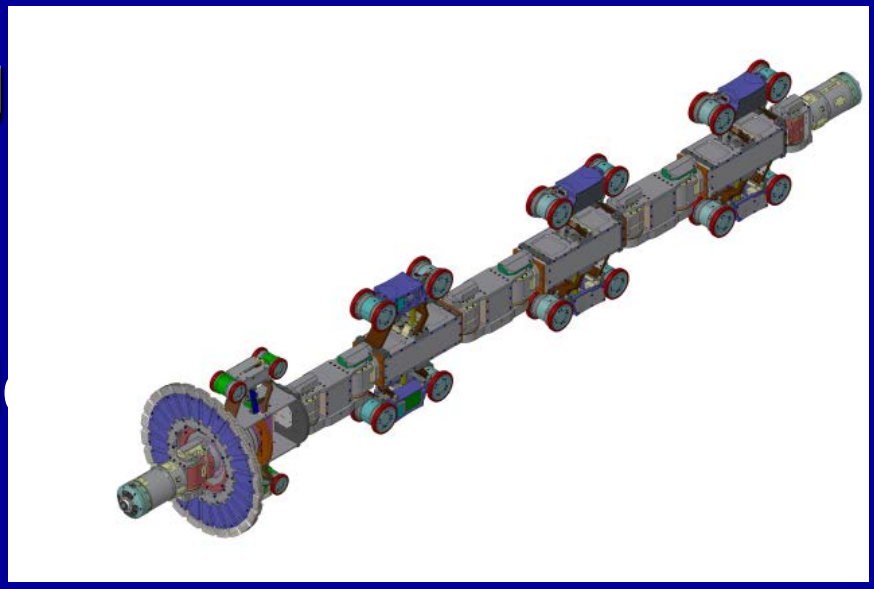




Technologies for Enhancing Explorer Operations

- Extending the range of batteries
  - In-line charging; implemented in all Explorer robots
  - On-board energy harvesting
- Unpiggable pipeline cleaning tool
  - Able to remove heavy debris and some liquids in unpiggable pipelines
  - Available on X20/26





Looking Forward - Gaps

- Extend range of robotics tools
  - Power issue – being addressed; more work needed
  - Wireless range
- Defect detection and characterization in bends
  - Develop defect database and validate tools
  - Dedicated sensors?
- Crack detection; still a lot to be done
  - New crack detection technologies
  - Crack characterization; develop defect database and validate tools

Looking Forward – Gaps (cont'd)

- Inspection of plastic pipe and plastic joints
  - Plastic infrastructure is aging and shows first signs of health issues
  - Defect detection technologies
    - UT reigns but has well established limitations
    - Explore other technologies such as X-Ray, THz, etc.
  - Platforms to deploy in the field
    - Handheld
    - In-line inspection; platforms used in transmission pipelines not suitable for plastic pipe

THANK YOU

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