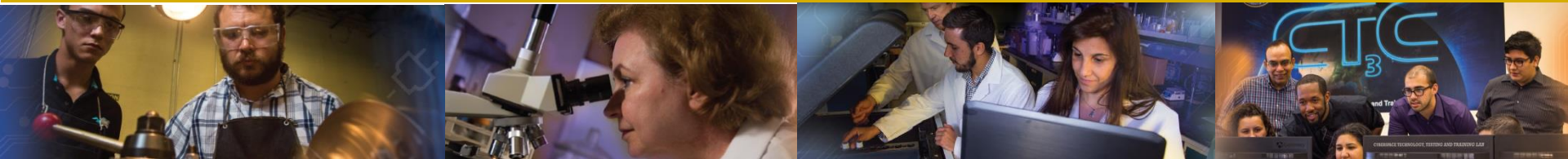




Development of an Inspection Tool for Secondary Liner in Double Shell Tank

Christopher Excellent (DOE Fellow)

DOE-FIU Science and Technology Workforce Development Program
Applied Research Center
Florida International University





Team



Anthony Abrahao, MS
Research Scientist
Applied Research Center



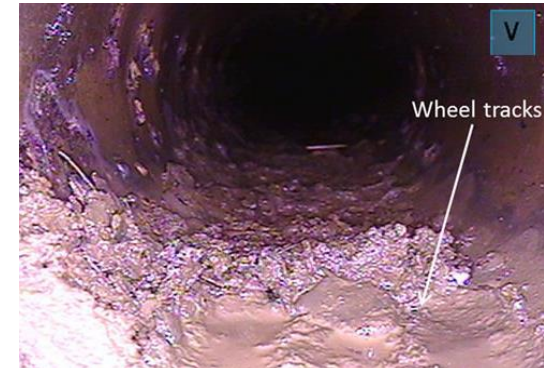
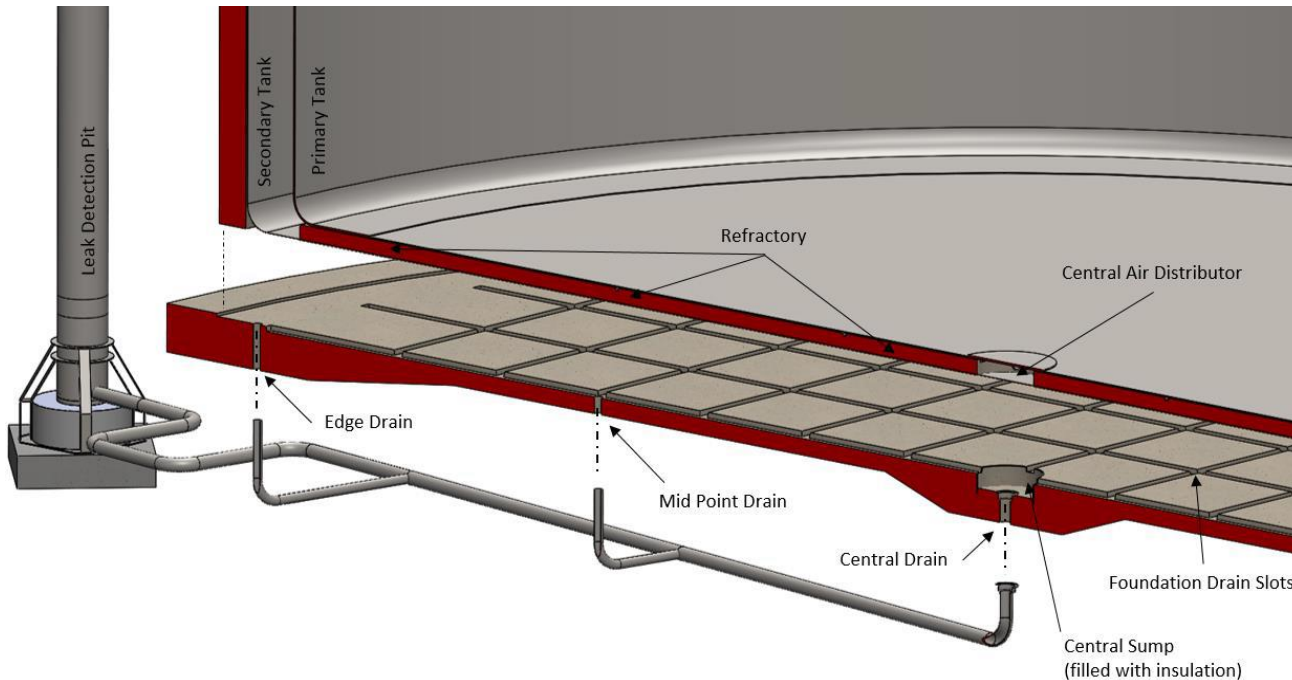
Christopher Excellent
DOE Fellow
Mechanical Engineering Department



Proposed Inspection

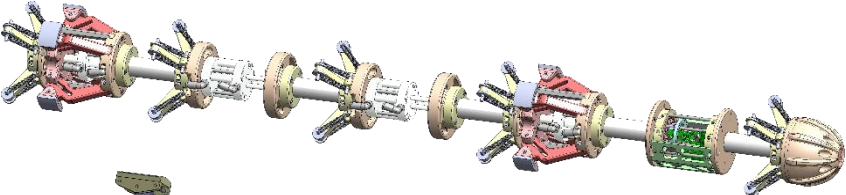


“Develop an inspection tool that navigates through the foundation drain slots under the secondary liners of the DST’s at Hanford while providing live video feedback.”

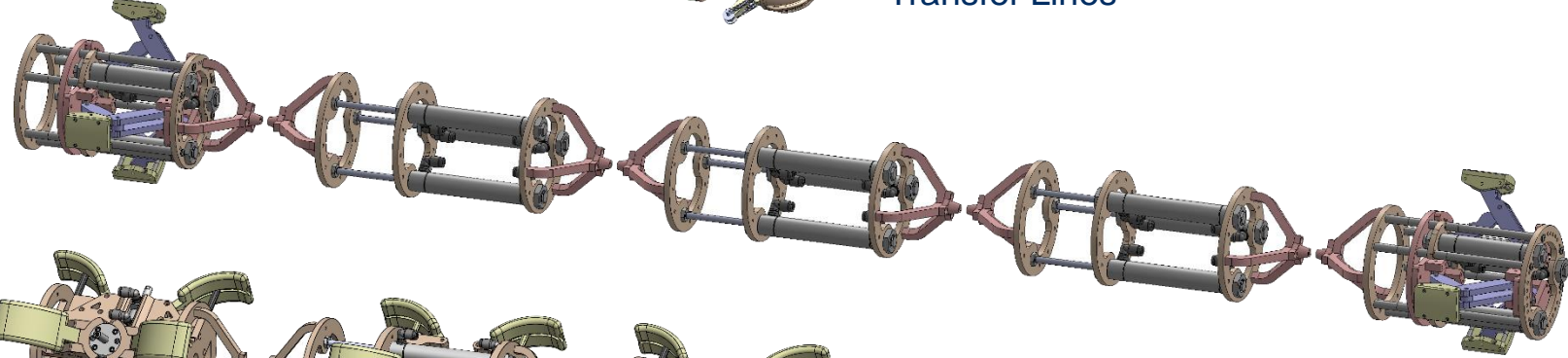




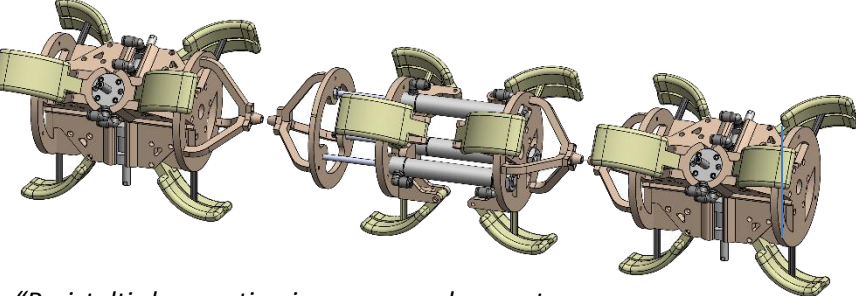
FIU's Peristaltic Pipe Crawlers



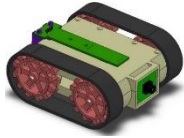
DST's Ventilation Header, and Transfer Lines



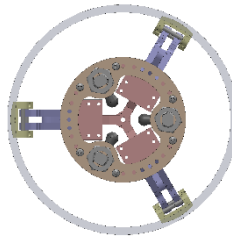
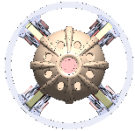
DST's Drain Line



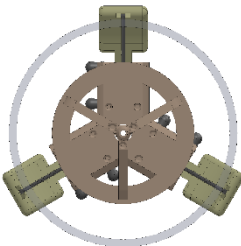
DST's Drain Slots



3"Ø & 4"Ø



6"Ø



"Peristaltic locomotion is a common locomotor pattern in elongated, soft-bodied invertebrates, particularly in segmented worms, such as earthworms. Forward movement is produced by contraction of muscles, which extends or elongates the body; contraction of the longitudinal muscles shortens and anchors the body" (Britanica, 2019).



Why Pneumatics?

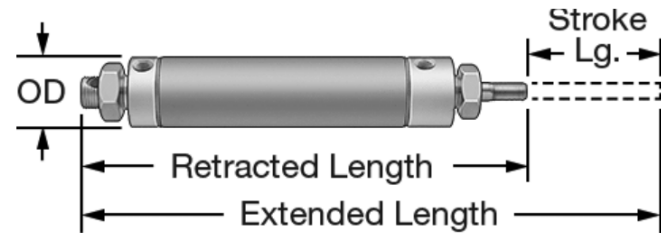
- Suitable for rough environment
- Relatively cheap
- Fast actuation
- Simple and accurate control of force
 - Area and pressure
- Simple and accurate control of velocity
 - CFM
- A high force-to-weight ratio
- Constant force or torque output
- Safety in hazardous environments
- No explosion risk

McMASTER-CARR®

sr-046-dpy-00mc

Round Body Air Cylinder

Double-Acting, Universal Mount, 1-1/4" Bore Size, 1" Stroke



Each

Delivers tomorrow 12-2 pm
\$51.29 Each
6498K972

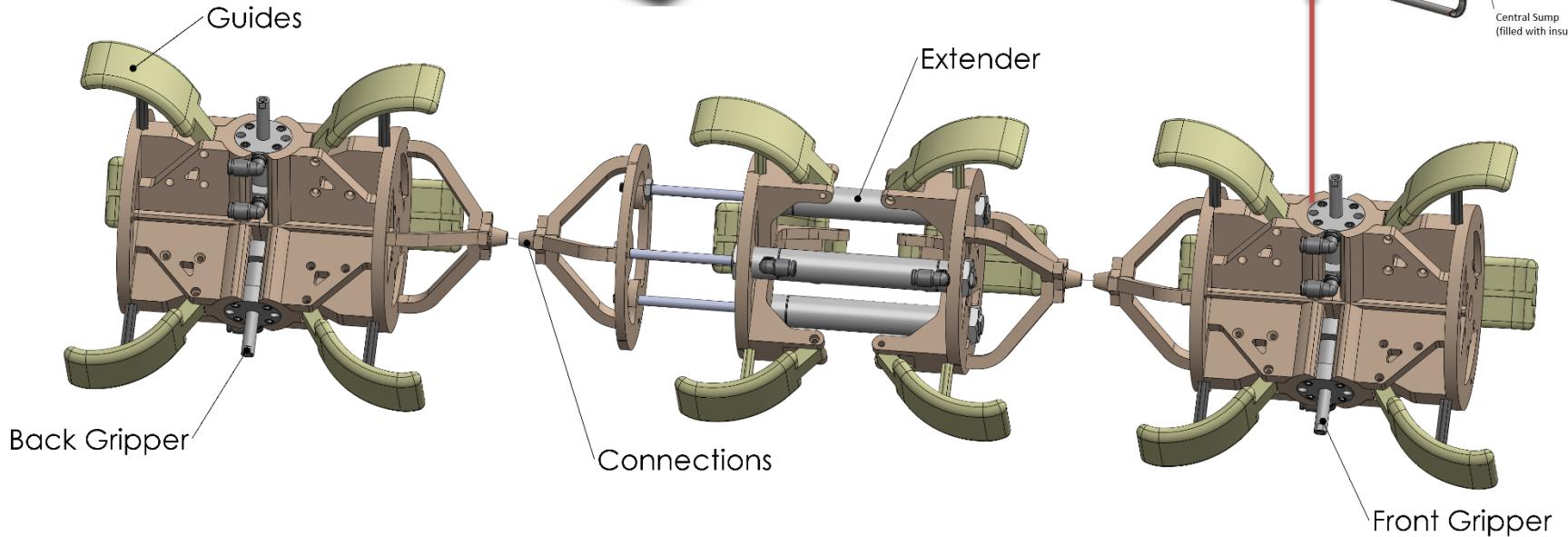
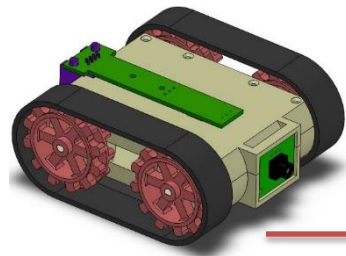
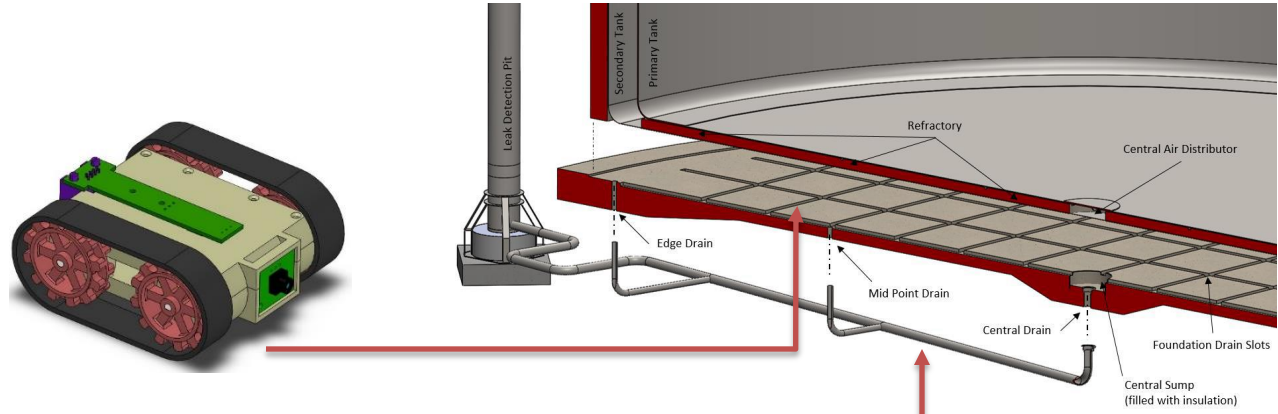
ADD TO ORDER

Motion	Linear
Air Actuator Type	Air Cylinder
Linear Air Cylinder Type	Round Body
Mount Type	Universal
Mounting Orientation	Any
Bore Size	1 1/4"
OD	1.34"
Length	
Stroke	1"
Retracted	6.88"
Extended	7.88"
Force @ 50 psi	60 lbs.
Force @ 100 psi	120 lbs.
Force @ 150 psi	180 lbs.
Force @ 200 psi	240 lbs.



Design

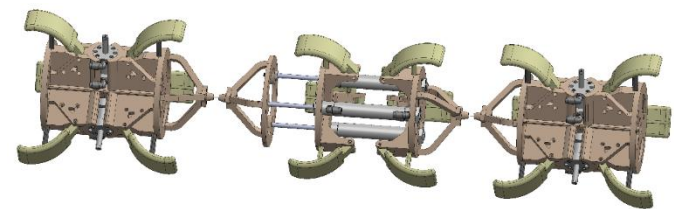
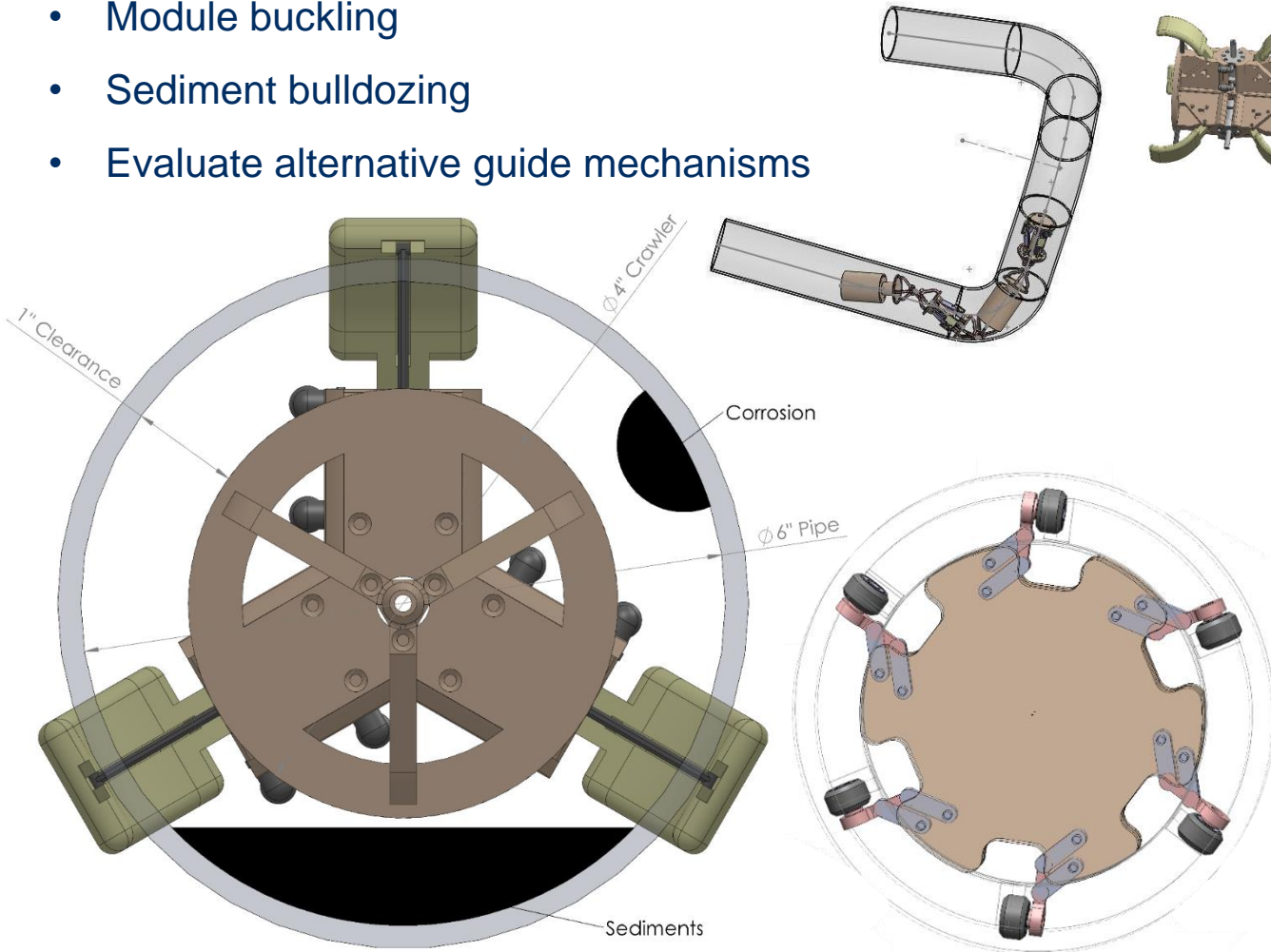
- Modular design
- Peristaltic locomotion
- Pneumatic actuation
- 3D printed parts





Challenges

- Module buckling
- Sediment bulldozing
- Evaluate alternative guide mechanisms





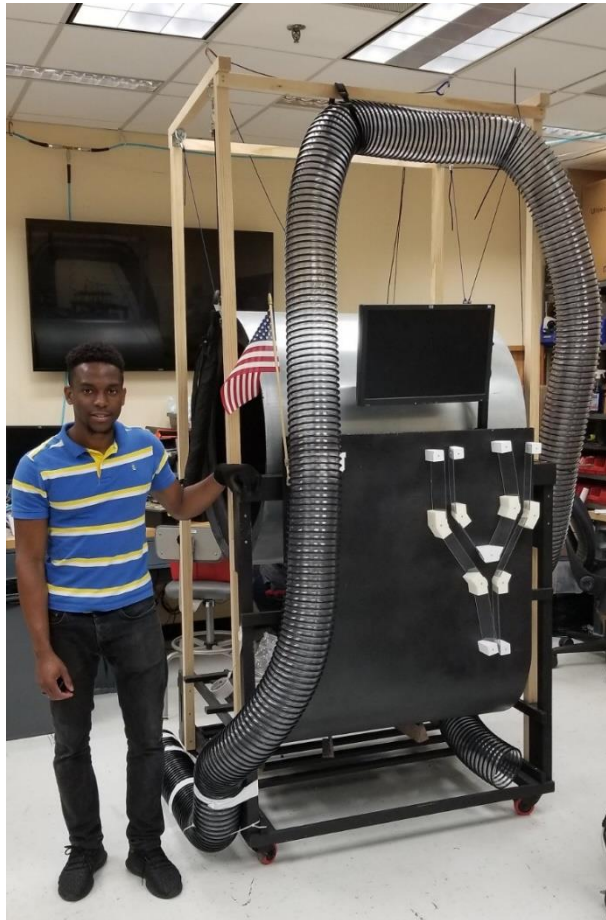
Prototype





Testing

Preliminary Maneuverability Tests



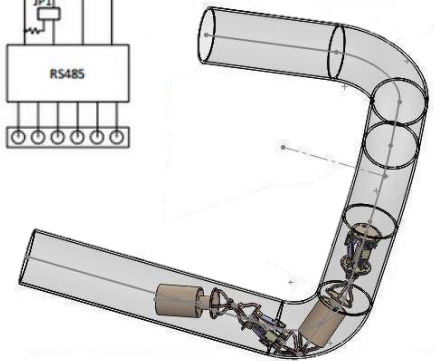
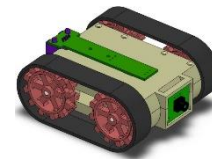
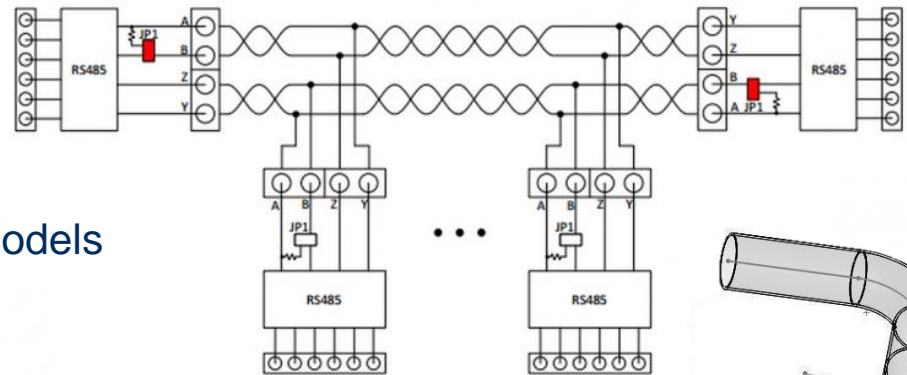
Following tests will include a full scale metal pipeline and sediments.



Path Forward and Ongoing Improvements



- a) Embark miniature pneumatics valves to modules
- b) Test new reinforced 3D printed materials
- c) Integrate high definition digital cameras
- d) Design a full duplex fieldbus tether:
 - power and data,
 - compressed air manifold, and
 - miniature inspection tool tether
- e) Implement Real-time distributed control
- f) Improve Multibody Dynamics simulation models
- g) Incorporate IMU to modules
- h) House miniature inspection tool in the front gripper
- i) Combine back gripper and cable management system





Acknowledgements



- **FIU ARC Mentors**
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 - Dr. Leonel Lagos
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