

2021 Virtual HBCU-UP/CREST PI-PD Meeting



Research Initiation Award: Cognitive Monitoring Systems using Intelligent Robots and Sensors in Dynamic Extreme Environments

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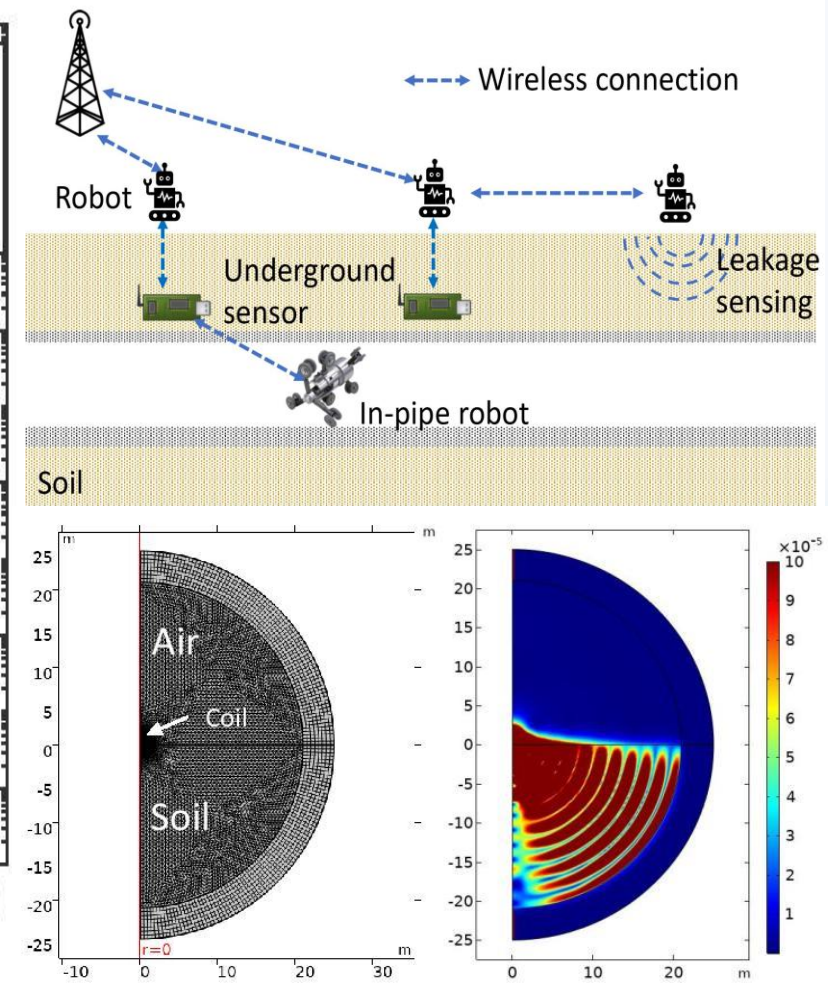
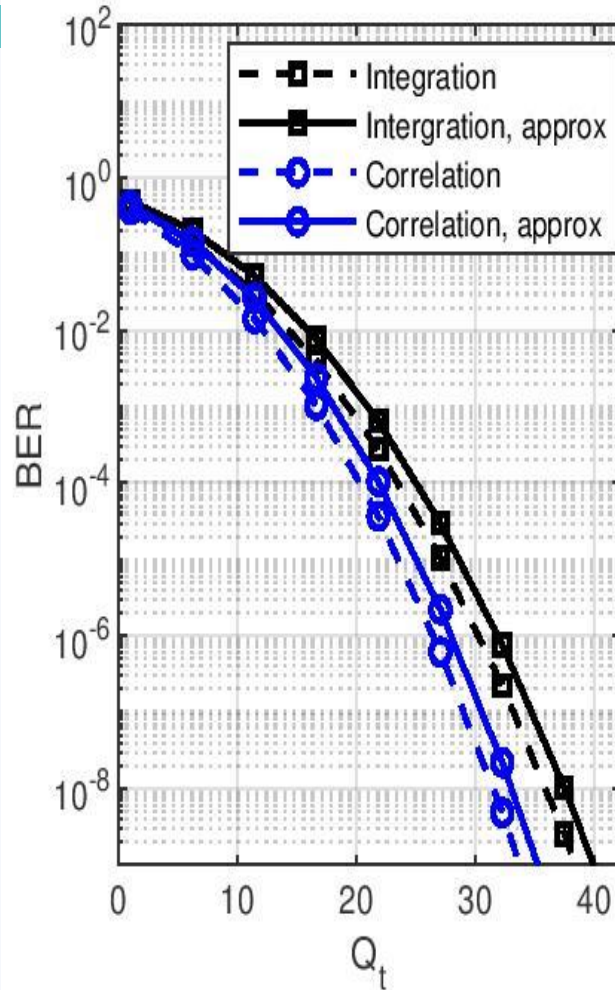
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All findings and opinions are those of the authors, not necessarily of the funding agency or AAAS.

Project Overview (05/01/2020-04/30/2023)

- Objective: leverage the cooperation between intelligent sensors and in-pipe robots to enable cognitive monitoring of underground pipelines
- Research tasks:
 - reliable physical communication design
 - intelligent network control
 - develop robust wireless networks in dynamic extreme environments
- Broader impact:
 - advance our knowledge of extreme environment communication and control
 - provide research experiences for undergraduate and graduate students
- Project webpage:
 - <https://ghz8910.github.io/upram.html>
 - YouTube: <https://youtu.be/iQ1My6R4Nig>








Research & Education Activities

- Research:
 - Wireless signal propagation in inhomogeneous media, i.e., through-soil and through-metal
 - Digital modulation for very low frequency (3kHz to 30 kHz) signals
- Education:
 - Senior design projects
 - Presentations for freshman class



Implications & Achievements

- Developed a **channel model** for magnetic communication in inhomogeneous media
- Developed an effective **direct antenna modulation** scheme for very low-frequency digital communication
- Publications:
 - “Joint Channel and Antenna Modeling for Magnetic Induction Communication in Inhomogeneous Media.” [H. Guo & A. Ofori](#), IEEE Open Journal of the ComSoc, 2020.
 - “BER Analysis and Optimization of Direct Antenna Modulation for Magnetic Induction Communication.” [R. Chapman, M. Prince, and H. Guo](#), IEEE Radio Wireless Week (RWW), virtual, Jan. 2021

Undergraduate RA		Senior Design	
			
Ryan Chapman	Marlin Prince	Mario Alcaraz	Chey'na Bunch
			
Terrell Washington		Bruna Goncalves	Steven Pringle

Identified Gap(s) for Future Collaboration or Enhancement

Intellectual merit

- Wireless communication and power transfer testbed design: tiny, efficient, and user-friendly
- In-pipe robot design and simulation
- Ground swarm robots task allocation

Broader impact

- Underground communication test will be performed on Virginia Tech's research farm
- Seeking for in-pipe test opportunities
- Outreach collaborations