

The **Ananya Sen Gupta Research Group** pursues research in signal processing, pattern recognition, and knowledge discovery, with an emphasis on applications to coastal environments and the Earth's Van Allen radiation belts. The research scientists seek to develop geometric computational techniques that enable sophisticated representation, localization, tracking, and classification of environmental processes. Sen Gupta's algorithms have been applied to shallow water acoustic communications, fingerprinting oil spills, and sonar target recognition in high-clutter coastal environments, as well as to tracking high-energy plasmospheric events on Earth and Mars.

Sponsors

- National Science Foundation
- Office of Naval Research, U.S. Department of Defense
- Air Force Office of Scientific Research, U.S. Department of Defense

Technology

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MIT Lincoln Laboratory

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- Iowa Space Grant Consortium
- National Aeronautics and Space Administration



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 - Technical Committee member, IEEE Ocean Engineering Society

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RESEARCH HIGHLIGHTS

Space-based research: Developing new interference cancellation techniques for constellation magnetometers that separate geophysical signals from spacecraft noise caused by reaction wheel mechanisms. This AFOSR (co-PI Dr. Sen Gupta) project involves collaboration with Dr. David Miles (PI) in Department of Physics and Astronomy, University of Iowa. Other smaller projects funded by the Iowa Space Grant Consortium (ISGC) include detection and pattern discovery of high-energy plasmospheric events such as chorus elements in the Earth's Van Allen radiation belts (collaboration with Dr. Craig Kletzing, Department of Physics and Astronomy) and escaping ion populations in the Martian ionosphere (collaboration with Dr. Jasper Halekas, Department of Physics and Astronomy). Dr. Sen Gupta is also participating as co-I in a P3 grant on space research led by the Department of Physics and Astronomy (PI: Dr. Philip Karaat).

Real-time marine sensing using underwater acoustics: (Solo-PI grants funded by ONR with Dr. Sen Gupta as PI)

- Adapting underwater acoustic communication networks to changing oceanic conditions using opportunistic signaling 1. schemes and morphological signal processing. Collaborator: Naval Surface Warfare Center, Panama City, FL.
- 2. Tracking Changes in the Shallow Water Oceanic Environment Using Geometric Feature Representation and Pattern Learning Techniques. Multiple academic collaborators on an ad-hoc basis depending on data used for this project
- Bridging the gap between artificial intelligence and expert interpretation in naval environments. Collaborators: Naval 3. Surface Warfare Center, Panama City, FL, and Cornell University.
- Leveraging manifold signal processing and information theory to enable efficient feature engineering for autonomous sonar target detection and classification. Collaborator: Naval Undersea Warfare Center, Newport, RI. 4.

Raw signal processing of chemical instrument signals: This project funded by the National Science Foundation (Dr. Sen Gupta (PI) and Dr. Keri Hornbuckle (co-PI)) involves raw signal processing and pattern recognition of chemical contaminants, target and non-target, across a broad range of environmental applications: Petroleum forensics and oil weathering studies, air pollution studies, food contaminant studies, to name a few. Collaborators include Louisiana State University, Woods Hole Oceanographic Institution, University of California Santa Barbara, the Food and Drug Administration, and Princeton University.

Research recognition: Dr. Sen Gupta's research with her students have attracted multiple student awards at the national and state level, including the prestigious National Defense Science and Engineering Graduate Fellowship award (Bernice Kubicek, PhD candidate), several lowa Space Grant Consortium (ISGC) awards, as well as the Career Kudos mentoring award by the University of Iowa.



Duration of event (in seconds)

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