Signal Sleuth – RF Interference Classification and Geolocation

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UNPARALLELED TECHNICAL EXPERIENCE

Photo: ULA

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- Dedication to Mission Success
- Technical Excellence
- Commitment to Our People
- Objectivity and Integrity
- Innovation

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Forging Connections Across the Space Enterprise

THE BENEFITS OF WORKING WITH A TRUSTED PARTNER

- Independent and unbiased nonprofit organization

- Broad perspective across the space enterprise

- Unparalleled support to diverse mission areas

- Unique insight into complex problems

- Inform best course of action for high-impact decisions

Background

- Satellites in low-Earth orbit have been experiencing GPS outages due to terrestrial interference sources.

- To further study this interference, Aerospace is flying payloads on its DiskSat constellation (https://aerospace.org/disksat) that will capture ~20ms RF samples on the L1 signal.

  - *These samples can be used to design algorithms that can classify and geolocate the source of these signals so that commercial users of PNT systems (e.g., airlines, cruise ships, etc.) can be provided the information they need to reconfigure their Positioning, Navigation and Timing system to be resilient to the interference in their local environment.*

Problem Statement

- Recorded RF data, especially when captured at a high sample rate, requires a lot of bandwidth to downlink to the ground from a satellite constellation. Therefore, it would be advantageous to process the RF captures <u>on the satellite itself</u> and only downlink interference classification and geolocation data.

- Aerospace will provide simulated RF data with representative Global Navigation Satellite System (GNSS) interference signals.

- The student team shall develop an algorithm (potentially machine learning) to classify an interference signal
  - *As potential stretch goals:*
    - optimize the algorithm to run on a low-size/weight/power computing platform (e.g., suitable for small satellites)
    - add jammer pointing direction estimation or geolocation capabilities
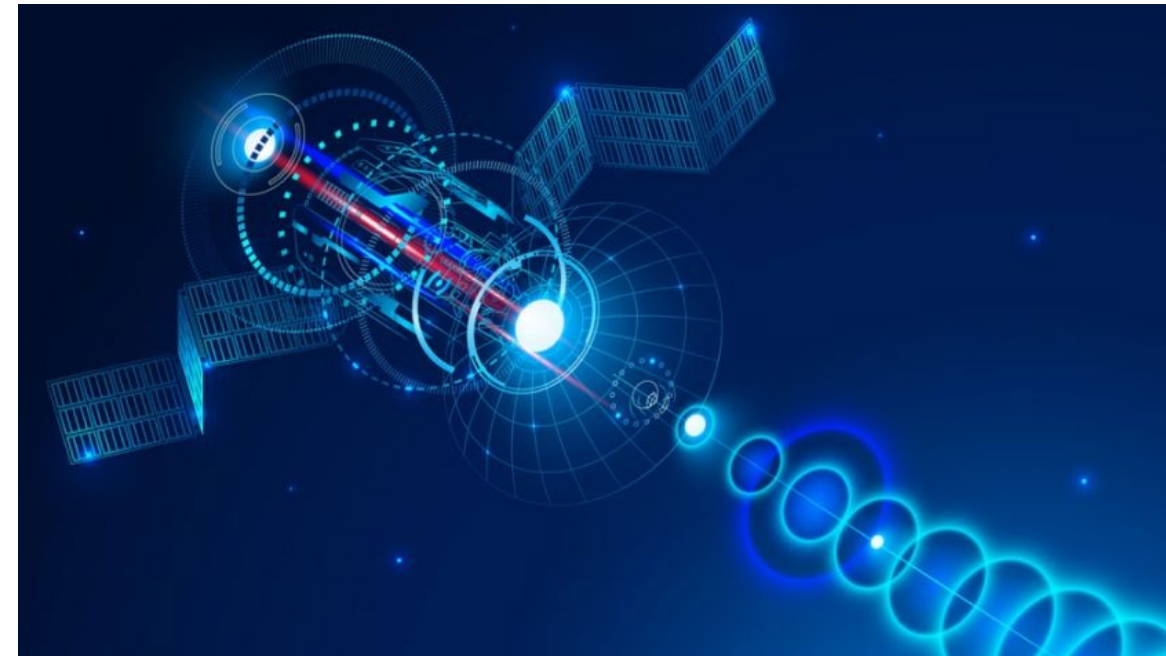
Relevant Engineering Disciplines and Skills

- Electrical Engineering
    - *RF signal processing (I/Q samples, spectrograms, etc.), receiver design, digital signal processing, embedded/realtime systems*
- Software Engineering
    - *Python*
    - *Software packages: numpy, scipy, pandas, matplotlib*
- Machine Learning
    - *Software packages: scikit-learn, Pytorch*
- Aerospace Engineering
    - *Estimation, dynamics and control, GNSS*

Questions?