Enable Real-Time Access to Underwater Acoustic and Beam-Forming Data on a Hybrid Aqua-Quad Vehicle

Data flow diagram of Acoustic Sensing, Processing, Communication
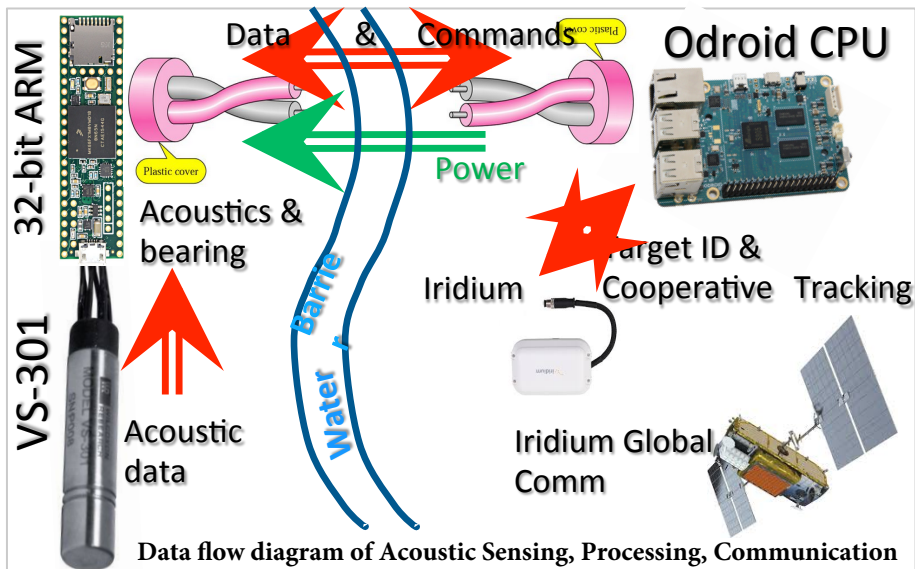
Objective:

- Break the communication barrier between the underwater and air domains by passing the deep-water sensing and preprocessed acoustic data to a remotely deployed Aqua-Quad platform.

- Enable adaptive reconfiguration of the acoustic sensing and processing in response to operational needs

- Key technical objectives include:

  - enable hard real-time sampling of acoustic and attitude data feasible for beam-forming calculation and losss-less data compression

  - integrate the preprocessed data into depth-to-surface communication channel for further target tracking at the surface level

  - design a "1-wire" communication capability to enable transmission of power and signal via a slender, very low volume flexible tether.

Background

- There is an ongoing need for improved autonomous methods to detect and track underwater objects, with mobility on demand, extended endurance and global communications reach for data and commands.

- The Aqua-Quad is a conceptual design to improve upon existing capabilities:

  - It combines the air mobility and agility of a quad-copter with the underwater sensing and stealth of a sonobuoy. Air mobility allows the Aqua-Quads to automatically respond on detected targets by re-positioning.

  - Persistence is achieved using solar cells to recharge batteries.

  - A passive acoustic sensor deployed at depth on a slender tether listens for underwater objects. DSP processing enables target ID and beam-forming.

  - Cooperation with other nearby Aqua-Quads provides accurate target identification, localization and tracking.

Technical Approach:

- Design a communication channel between the surface and the acoustic sensor for depth-to-surface communication and power supply:

  - Design embedded software capable of adaptive sampling of acoustic and attitude data and solving of beam forming task.

  - Design curcuitry to enable power injection and signal selection to/from single wire communication tether.

  - Design a single-wire serial communication protocol capable of robust two-way communication; communication of acoustic data and commands.

  - Analyze power and signal loss effects of long distance transmission.

  - Perform long-term tests of the power and communication system to evaluate system lifespan.

FY19 Call for Proposals

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