Aerial Drone Tracking with Passive Sonar

Description:

Metron Scientific Solutions is interested in developing a system to track aerial drones by listening for the sound waves they emit. The desired system will utilize a multi-channel A2D that will digitize audio from multiple microphones, process the data, and display it on a user interface. The concept of how this works is that sound waves passing by a set of microphones that are held fixed in space can be processed in such a way as to determine where the sound originated from (often called beamforming). Metron will assist in developing the signal processing software needed to do this processing, and provide guidance on how to design such a system. Students will be responsible for actually designing and building the A2D hardware, 3-D printed microphone array frame, and UI software components. The final delivery will consist of demonstrating a functional system. Metron will procure the necessary materials identified by the students, within a reasonable budget. The software would ideally consist of user interface leveraging Glimpse 3.0, a GPU-accelerated Java library. A possible alternative to building a user interface would be a mechanically steered nerf gun to fire at the drone, or alternatively aiming a laser pointer. We encourage creativity for this part.

Why should you pick this Capstone?

If you are selected for this Capstone, you will be involved in the entire project, from finalizing the product requirements to demonstrating a finished prototype. It will be a very hands-on project and require engineering prowess spanning multiple domains. This is a unique opportunity to apply your creativity an interesting and fun demonstration target tracking system.

Major tasks:

- **System architecture:** Meet with Metron engineers to learn the basic requirements for the microphones, A2Ds, array frame, and software. Translate that into a design document and submit to Metron engineers for final review/feedback.
- **Passive sonar:** Design, procure, and program an A2D converter to digitize multiple audio channels synchronously, and also obtain a data feed for the raw data that is accessible to the software.
- **Array design:** Use CAD software to design a frame capable of holding the microphones at specific points in space. 3-D print the components and assemble.
- **Software:** Develop a simple UI to display the direction in which sound is arriving. This will involve working with Metron engineers to code up the signal processing components.
- **Target tracking:** Demonstrate operation by hovering a drone nearby, and see its direction show up on the UI display.
- **Aiming/intercept (alternative to UI):** Design and implement a target intercept subsystem that responds mechanically to the sound direction.

Desired Skills:

- A2Ds, Arduino, or Raspberry Pi systems
- CAD and 3-D printing
- MATLAB and/or LabVIEW software
- PC-based programming – C/C++/Java.
- Very basic digital signal processing, such as FFT and the Nyquist sampling theorem