# Development of Machine Learning Model for Drone Tracking Using Acoustic Sensors

**About DEVCOM ARL:**

The DEVCOM Army Research Laboratory conducts basic and applied research for the Army. Its mission is to operationalize science for transformational overmatch. The basic research conducted at the laboratory leads to capabilities for soldiers to fight and win on the battlefield. The Vehicle Applied Research Branch specifically conducts experimental and computational research in rotary-wing and other vertical lift technologies at both manned and unmanned scales.

**RESEARCH LOCATION:** Aberdeen Proving Ground, MD

**PROJECT DESCRIPTION:**

The goal of the project is to determine how accurately machine learning models can be used to determine the location and movement of a small, unmanned aircraft/drone based on acoustic data collected using one or more virtual microphones. An array of virtual acoustic signals at multiple locations from the drone will be synthesized using DoD/Army and university computational tools at various flight conditions for model training. The raw acoustic signals will be processed to obtain spectrograms of the signals, and the machine learning models will be developed using deep convolutional neural networks to determine the position and flight path/speed of the drone from the spectrogram signals.

The scientific objective of this project is to see if a machine learning model is able to determine the location and movement of a small UAS based solely on acoustic data from one or more virtual sensors. The intern will use a simulation model (e.g. Army's Rotorcraft Comprehensive Analysis System, RCAS) combined with an acoustics code PSU-WOPWOP to generate an acoustic sphere for a small UAS flying along a particular path. PSU-WOPWOP can also calculate the propagated noise at multiple stationary observer locations. These noise sphere and ground noise dataset will be generated by varying UAS flight paths, distances, speeds, and directions. The noise dataset will be processed into a spectrogram dataset. The machine learning models based on deep convolutional neural networks will be trained using the spectrogram data to localize the location/movement of the UAS. The model structure will be optimized using a hyper-parameter tuning process. The base goal would be to evaluate machine learning models based on a single sensor with additional goals of developing models using multiple sensors. The aircraft used would be notional aircraft to avoid any sensitivity around military vehicles.

The intern will be given the opportunity to conduct research in an Army-relevant program using state-of-the art computational tools such as the Army's Rotorcraft Comprehensive Analysis System (RCAS), the acoustics code PSU-WOPWOP, and machine learning tools. Often there is a training class offered near the start of the internship where the intern can learn RCAS, and mentors will provide training on any software tools the intern is not already familiar with. ARL has several in-house tools which automate some of the research, such as adding acoustics information to an RCAS model.

In past years, as a result of their internships, interns have learned to use a number of government-owned computational tools which they would not have access to at school, which makes them more interested in and marketable to the DoD and aircraft companies. Many have co-authored papers and even gone on to be hired into DEVCOM ARL, hired elsewhere within the DoD or by aircraft industry companies and many have returned to ARL or interned at other Army research facilities. Exact research will depend on the intern's prior experience and interest. Under the guidance of mentors, the intern will gain knowledge in:

- Developing RCAS aircraft models and running cases for different flight paths
- Run PSU-WOPWOP to generate acoustics data and process into training data for a machine learning model
- Train and evaluate machine learning models to determine what is most effective.

The prior steps can be repeated for different aircraft, sensor configurations, or machine learning algorithms based on what is learned

**ANTICIPATED START DATE:**

May/June 2026 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

**QUALIFICATIONS:**

The ideal candidate will be currently pursuing a master's or doctoral degree in aerospace engineering with education or knowledge in vertical lift/rotorcraft, acoustics, and machine learning.

Favorable knowledge include:

- Rotorcraft dynamics
- Acoustics and sound propagation
- Machine learning
- Scientific programming in languages such as MATLAB or Python
- Experience with government software tools including RCAS, Helios, PSU-WOPWOP

**ACADEMIC LEVEL:**

Degree received within the last 60 months or currently pursuing:

- Bachelor’s
- Master’s
- Doctoral

**DISCIPLINE NEEDED:**

- Computer, Information, and Data Science
- Engineering
- Science & Engineering-related