Simulations and Machine Learning for Parachute Navigation
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Generating Flight Paths (MATLAB)
- Import Real World GPS Flight Paths
- Convert Differences
- Export to CSV

Running Simulator (Unreal Engine)
- Import Path
- Set Starting location
- Collect Images and Locations

Building Dataset (Python)
- Match Images to Locations
- Pair Images Together
- Calculate Change in Location

Image Processing (OpenCV)
- Resize (240p)
- Grayscale
- Pairwise Histogram Normalization

Training Network (Turing + PyTorch)
- Error Metrics
- Activation Functions
- Architectures

Evaluation (Weights and Biases)
- Upload Samples
- Monitor Results
- Create Charts

Abstract
In the military, supplies are critical, and a common method for delivering supplies is via parafoil parachutes, guided by the GPS. However, signals from GPS satellites can often suffer from disruption, due to jamming or environmental factors. The goal of our project, in conjunction with DEVCOM-SC, is to develop a machine learning navigation solution using aerial image data, as a reliable GPS alternative. A previous MQP developed an initial neural network and determined generating more data was a crucial next step. To obtain a large quantity of labeled aerial images, we first created a virtual simulator for parachute drops. After collecting data using our simulator, we were able to apply a variety of preprocessing methods to the images and test different neural network structures to predict changes in parachute location.

Dataset Performance Evaluation

Cross Validation of Best Network
Percent Error = 30.19%
Root Mean Squared Error = 18.175

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Approved by DEVCOM-SC for public release.

References
- https://ccdcsoldiercenter.army.mil/
- https://cesium.com/platform/cesium-for-unreal/
- http://aima.cs.berkeley.edu

Image Intensity Equalization

Neural Network Structure

Performance Evaluation

Simulator

Training and Testing

Effects of Equalization on Multitask vs Single Task

Pixels

Percent Error

Loss

Percent Error