Deep Learning for Anomaly Detection

Overview
Machine learning has been making breakthroughs in the industry through providing automation, detecting anomalies, and processing huge amounts of data (i.e. “big data”). A potential application for this technology is in the field of aeronautics to assist pilots by providing a peripheral system that detects operational aircraft anomalies throughout flights in real-time. This is a proof-of-concept project that aims to use machine learning algorithms to detect failures in a flight simulator using visual representations of an aircraft’s cockpit.

Objectives
- Configure environment setup for FlightGear simulator consisting of scripts to automate the process of running flight operations, feeding anomalies at random intervals, and capturing screenshots of the simulator to be used as input for the machine learning model.
- Train and test the TensorFlow model to perform image classification on sets of sequence of frames to determine whether there is an anomaly present or otherwise, alongside a confidence threshold of the classification prediction.

Approach
- Scheduled bi-weekly teleconferences with Barbara Peffley and Ben Lancki of Lockheed Martin to discuss objectives and progress updates throughout the semester.
- Reviewed and evaluated existing image classification projects that implement similar technologies (i.e. scikit-learn, Caffe, Weka).
- Wrote a Python script to randomly feed in various anomalies to the FlightGear simulator.
- Developed another script that captures screenshots of the cockpit every half a second to form the input dataset.
- Categorize sequence (or chunk) of images as “non-anomaly” or “anomaly” for model to identify the ideal samples from the other.
- Performed cross-validation and split dataset into 75% training set and 25% testing set.
- The trained model is an unsupervised learning classifier that predicts whether a chunk of images is anomalous or otherwise.

Outcomes
- Machine learning has great potential to be a feasible solution for an anomaly detection system in aircrafts.
- Larger training datasets and more specific visual representations can improve classification accuracy.
- Assist beginner pilots in their understanding of possible types of anomalies via simulations.