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CSCE823 – Dr. Borghetti

Project Proposal

My thesis is a sort of follow-on to the research conducted by 2d Lt Marvin this past year on detecting GPS spoofing using data obtained from the MIL-STD-1553 bus on USAF assets. For the purposes of this project, I would like to assess the accuracy of a more simplistic model than the neural network approach Lt Marvin took. Specifically, I would like to answer the question: can GPS spoofing be detected using simple classification models with parsed 1553 data? This is an important question to answer because countless USAF systems depend on accurate GPS messages for navigation and timing, and GPS signals are becoming increasingly easier to spoof with the proliferation of software-defined radio and similar technologies. A basic bus monitor with a well calibrated algorithm would provide a reliable, lightweight solution to this issue.

For this project, I would like to classify this temporally organized signal data that is passed along the bus using an unsupervised method. This would be a problem of binary classification, whether the signal in a given message is spoofed or not. The data is existing in a sense, but will be used to simulate other signals and generate more data. The existing data comes from the ANT center, and was recorded from real flight tests. It will be used as truth data to generate simulated sensor data for the GPS (spoofed and unspoofed) as well as IMU/INS data, and some other avionics components dependent upon implementation availability within the ANT center’s Fly simulation software. This experiment will primarily focus on the algorithm detecting the attack within an integrated GPS/INS, or IGI, model. The avionics components will be reporting position, velocity, and attitude information to the algorithm. The implementation of the spoofing attack will provide the labels for the data. The data will need to be parsed from the LCM log file into a Pandas dataframe for use by the algorithm. The number of observations is unknown at this time, but each will contain at least 18 features: position, velocity, and attitude for both GPS and INS. Position, velocity, and attitude will be vectors of 3 components each, in the x, y, and z directions. These features are all numerical.

The target variable is categorical, either spoofed or unspoofed. The truth labels will be generated by the spoofing simulation that I will implement in tandem with Fly. I will determine what samples to implement the spoof on based on the total number of observations, in an attempt to balance the representation of the two classes. The primary performance measure will be the accuracy of predictions on unseen flight data. Other measures will include true and false, positive and negative rates, as well as precision.

The results will directly contribute to my research. Hopefully the finalized dataset for my research will be complete in time to use the full scope of it in the project, otherwise the project will make use of the portion of it available at the time. The project has the potential to serve as the bulk of the experimentation for my thesis. This project is similar in nature to my project from CSCE623, but will be using entirely new data and new machine learning techniques.