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CSCE623 – 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 the project, I would take a supervised approach to this classification problem. The classification is binary, simply detecting what GPS messages contained spoofed information and those which do not. An unsupervised approach would also be interesting to assess, but may be difficult to implement with the data that is currently available. I will be using existing data for the project, the data that Lt Marvin used in his thesis, generated by the AVAS system from AFRL. If other data can be obtained in the near future, either real data from flights or more realistically spoofed simulated data from a simulator like FlightGear, that may be worth pursuing, but is unlikely to occur within the timeframe necessary for this project. I have both the raw data from the 1553 bus and the parsed data that Lt Marvin used for his thesis, ready to be used, and will likely use that, but may have to tinker with the normalization of it at some point.

There are approximately 700,000 observations per flight, and a total of 5 flights that were recorded. Each observation has 13 features: GPS Latitude, GPS Longitude, GPS Altitude, ADC Altitude, ADC Air Speed, EFIS Angle of Attack, INS X-Velocity, INS Y-Velocity, INS Z-Velocity, INS X-Acceleration, INS Y-Acceleration, and INS Z-Acceleration. All of these features were recorded by the bus monitor and then parsed out from the 1553 messages. All observations have also been flagged as spoofed or not, providing the “truth” data. As aforementioned, there are two classes for the classification of this data, spoofed and not spoofed. There is equal representation of spoofed and normal GPS recordings in each flight. 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. While this will not be the final dataset used in my research, the ML pipeline developed for this project will be the basis of it and will help tailor the rest of my methodology.