Senior Design Project in Electrical Engineering

GPS Spoof Detection using INS Data

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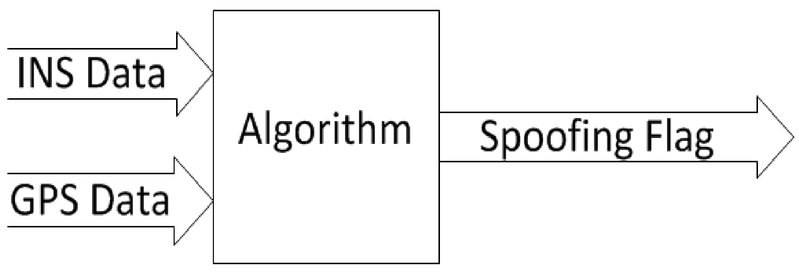
Background

GPS Spoofing is an attack in which a ship's GPS receivers are overpowered by false signals, displaying an incorrect position solution to the user. This project aims to reduce risk and increase integrity for reliance on GPS receivers in the Coast Guard by utilizing data given from the currently installed Mark-39 Inertial Navigation System (INS). The project utilizes GPS antenna route tracing comparisons to be able to determine if the GPS receiver's displayed information is valid.

Spoofing Scenario

Block Diagram



Problem

1. Coast Guard is shifting to electronic navigation
2. GPS is highly vulnerable system heavily relied on
3. GPS Spoofing will be easier to attack as technology moves forward
4. GPS Spoofing detection methods must be created to prevent damage of Coast Guard Assets.

Benefits of INS Data Integration Solution

❖Uses Commercial Off-the-Shelf (COTS) GPS Receivers and Inertial Navigation Systems INS

❖Coast Guard shipboard system (SeaWatch) is INS capable

❖Real time GPS spoofing detection

❖Independent of known good GPS fix

❖Single Antenna Solution (Low Cost)

NovAtel ProPak V.3 Test Receiver

Coast Guard Mark-39 INS-Capable System

GNSS Simulator to Test Algorithm on Receiver

Conclusions and Recommendations

❖High reliance of maritime industry on GPS

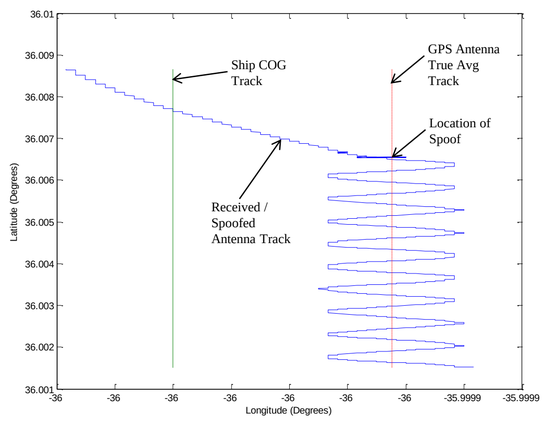
❖Algorithm successfully identifies spoofing in test environments

❖Coast Guard should investigate methods for spoofing protection

❖Any single method of detection has flaws

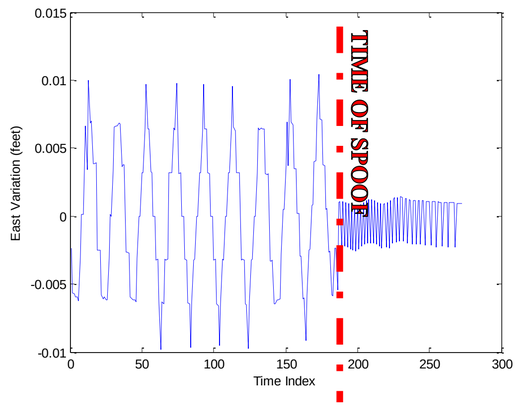
❖Recommend Coast Guard invest in receiver with multiple spoof detection capabilities

Spoofing Scenario

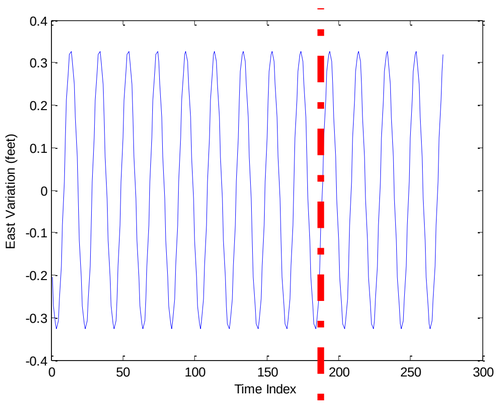


Algorithm Procedure

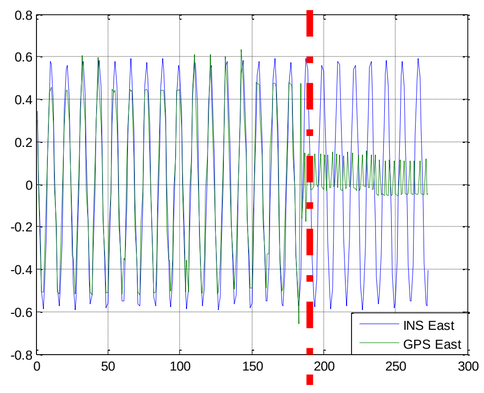
1. Remove velocity from GPS longitude to convert to east movement



2. Convert INS pitch and roll data to east movement



3. 1-Dimensional comparison of east movement



3. Repeat Steps 1-2 for north/latitude and calculate 2-D complex correlation