CRII: SaTC:
Cyber Resilient Localization and Navigation for Autonomous Vehicles

Mizanur Rahman, Ph.D. (PI)

mizan.rahman@ua.edu

Project URL: https://mrahman.people.ua.edu/research.html

NSF Award Link (Award # 2104999): https://www.nsf.gov/awardsearch/showAward?AWD_ID=2104999&HistoricalAwards=false

Goals

- **Research Thrust 1:** Investigate and develop an approach to detect intentional and unintentional interference of Global Navigation Satellite System (GNSS) services, by predicting and identifying vehicle states using data from low-cost in-vehicle sensors (e.g., gyroscope, accelerometer, and steering angle sensor)
- **Research Thrust 2**: Investigate and develop an integrated cyber resilient system using data from in-vehicle sensors and on-board Geographical Information System (GIS) to navigate an autonomous vehicle (AV) for a long duration towards its desired destination in a GNSS-denied environment

Challenges

- Detect unintentional and intentional GNSS interference using in-vehicle sensors
- Generate location data (latitude and longitude) in a GNSS-denied environment
- Guide an AV to a destination for a long duration in a GNSS-denied environment

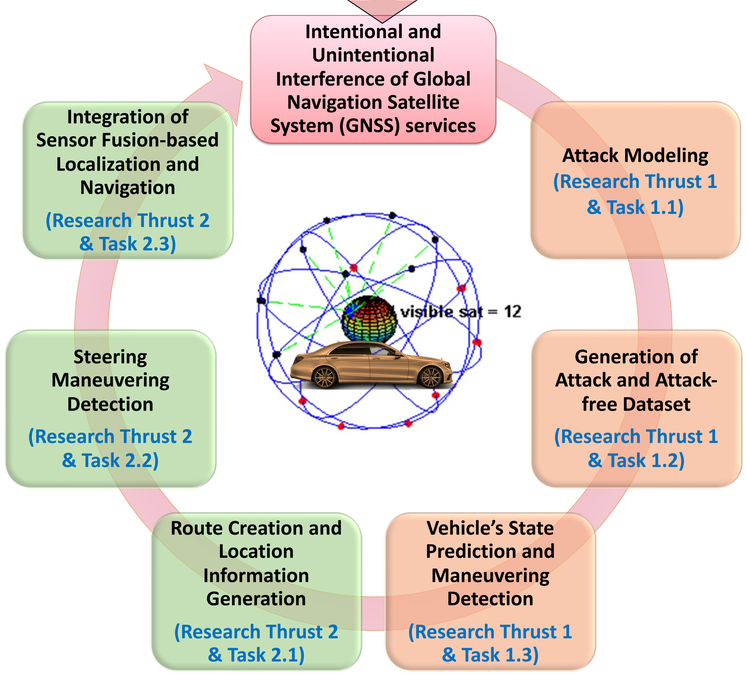
Scientific Impacts

- Enable a new paradigm of GNSS security solutions only using low cost in-vehicle sensors
- Model in-vehicle sensor fusion and geographical information systems to generate localization information (latitude and longitude) for a long travel duration in a GNSS-denied environment
- Enable an AV to navigate for a long duration between an origin and a destination in a GNSS-denied environment, a feature that could be extendable to other future automated vehicles (e.g., drones, flying vehicles) fields

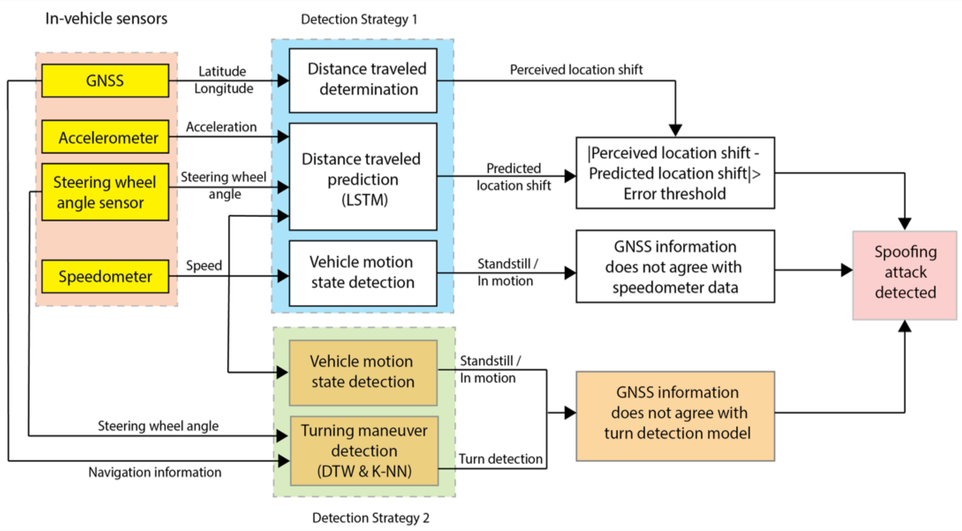
Research Approach

Research Questions

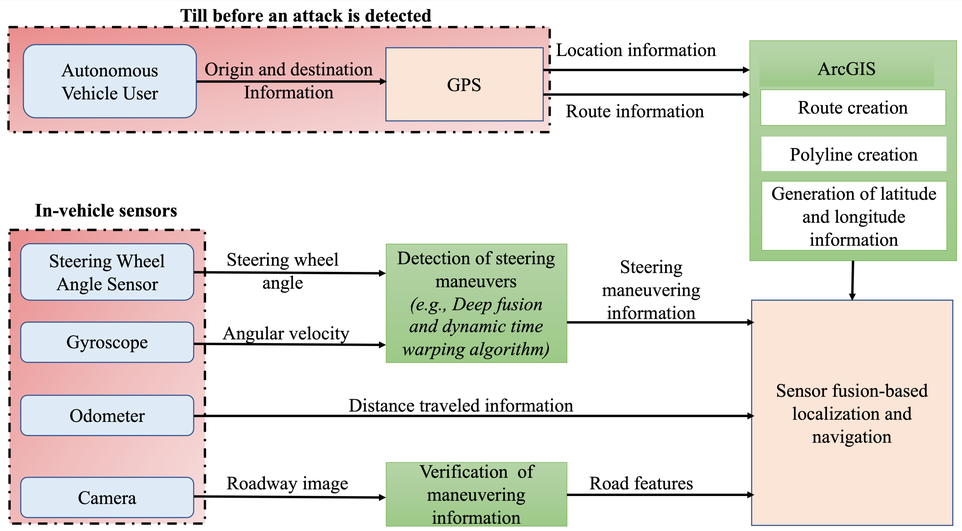
- How can the fusion of in-vehicle sensors provide a general approach to detect unintentional and intentional GNSS interference?
- How does one generate location data (latitude and longitude) in a GNSS-denied environment?
- How can one guide an AV to a destination for a long duration in a GNSS-denied area?



Research Thrust 1: GNSS Interference Detection Framework



Research Thrust 2: Cyber Resilient Localization and Navigation Framework



Impacts on Society

- Improve AV safety by transforming localization and navigation of autonomous vehicles under intentional and unintentional interference
- Ensure reliable operation of AV under intentional and unintentional interference
- Increase AV user acceptance by improving reliability of AV navigation

Impacts on Education and Outreach

- Give talk (webinars) at the UA and other universities
- Present research outcome at the conferences
- Develop creative inquiry courses focusing on GNSS security and involve K-12 students in AV security
- Develop a new graduate course titled, "Transportation Cyber-Physical Systems", which includes GNSS spoofing attack detection framework for AVs module

Broader Impacts and Participation

- Extendable to other future automated vehicles (e.g., drones, flying vehicles) fields
- Involve K-12 students into lab research
- Increase the number of female and ethnic minorities participation in AV security by recruiting students from existing NSF's Louis Stokes Alliances for Minority Participation (LSAMP) program and the Association for Women in Science (AWIS) at UA