COMP39/9900 Computer Science/IT Capstone Project
School of Computer Science and Engineering, UNSW

Project Number: P25

Project Title: Automated testing for software-defined GPS receiver

Project Clients: Ignatius Rivaldi

Project Specializations: Software development; Internet of Things (IoTs); Testing, signal processing.

Number of groups: 3

Background:

Software defined GPS receivers calculates position, velocity and timing (PVT) solutions from received GPS signals captured from a software-defined radio (SDR). Australian Centre for Space Engineering Research (ACSER, https://www.unsw.edu.au/research/acser) develops its own in-house receiver as part of our GPS research. Additionally, we also use open source software receivers, such as GNSS-SDR, FGI-SGRx and JuliaGNSS.

However, a simple software bug, such as a wrong sign in one of the navigation equations, will lead to a very wrong position solution. One of the example of this was found on an open source GPS receiver: https://github.com/JuliaGNSS/PositionVelocityTime.jl/issues/8 , where a simple sign mistake leads to 800 m position error.

Other than the obvious problem of leading the user to the wrong location, ACSER is using these software receivers as part in related GPS research, such as using reflected GPS signals from Earth's surface to determine its properties, such as ocean wind speed and determining sea ice boundary. These depends on correct PVT solutions generated from these software receivers to generate the correct output.

To test the receivers, ACSER owns several GPS simulators. These simulators can generate simulated GPS signals in different scenarios, such as a stationary receiver or a receiver traveling in low Earth orbit. The simulators can output the truth data, allowing us to compare the accuracy of the software receivers. However, the simulators need to be manually set up, which makes it hard to do automated testing.

In summary, our goal for this project is to:

- Automate the setup of GPS simulator
- Interface with the receiver to get PVT solutions
- Compare the solutions generated by the receiver with truth data generated by GPS simulator
- Automate these three steps, so that this testbench can run as part of a CI/CD workflow.

Requirements and Scope:

The MVP is to create automated test driver for two GPS simulator and two software receivers, with a web interface to visualise the results.

- Create a library to interface with GPS simulators, allowing for full automation
- Design a system to gather navigation results from GPS receivers under test

- Compare navigation results with ground truth data generated by GPS simulator, following common GPS accuracy criteria

- Integrate with GitHub Actions / other CI/CD system to automatically run the tests

- (maybe) Use signals from publicly available datasets, such as NASA CYGNSS or sdr.ion.org as part of the testing datasets

Required Knowledge and skills:

- Python programming skills

- Statistics knowledge

- Willing to learn Dash web dashboard framework.

Expected outcomes/deliverables:

TBC

Supervision:

Ignatius Rivaldi

Additional resources:

Some GPS accuracy criteria: https://gnss-sdr.org/design-forces/accuracy/

Open source GPS receiver: https://gnss-sdr.org/

For project coordinator: Eamonn Glennon (e.glennon@unsw.edu.au) might have submitted this project already, if yes then just merge it