# Inertial Navigation Data Simulator

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## Abstract

Synthetic Aperture Radar (SAR) is a modern radar imaging technique. The key constraint of this technology is that it can only be used from moving platforms while aimed at stationary targets. Fortunately, these instruments are commonly employed in this manner. However, issues arise during their development, as a moving platform is also required during testing. A common solution is to simulate movement by sending the SAR instrument inertial navigation data. Current simulations are hard-coded to devices that can send this data to the SAR instrument reliably at a constant desired rate. Unfortunately, the required rate and format of input vary among SAR instruments, and these devices only work for a single variation. This project aims to develop an application that provides a more flexible solution, where simulated aircraft movement can be sent to a wider range of SAR instruments.

## User Interface

The graphical user interface (GUI), as depicted in Figure B, allows users to manage waypoint lists offline and remotely interface with the simulator to control flight plans (Figure C). The center of the GUI is the flight panel: a component that provides visual feedback of the flight plan and the plane at its current location.

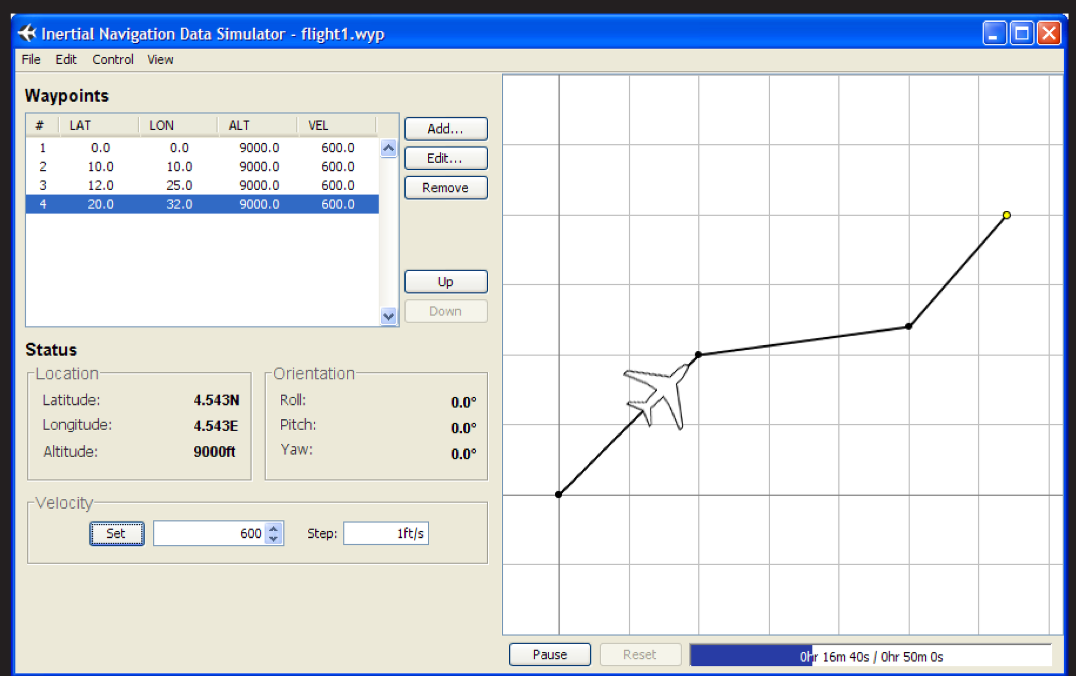


*Figure B: The Client Interface.*

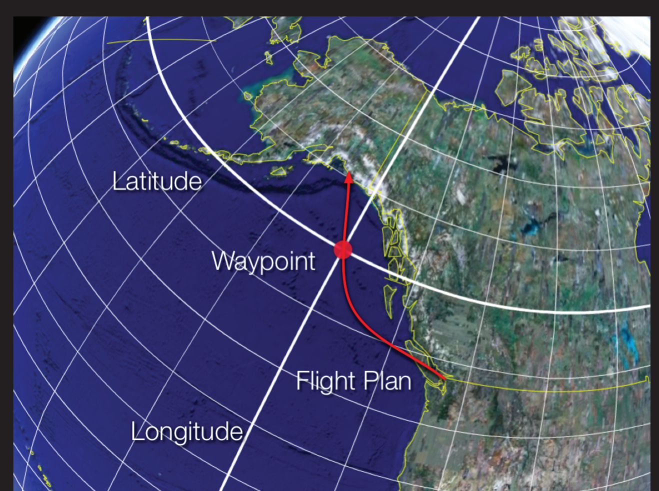



*Figure C: Flightpath & Waypoints.*

## The Approach

We selected an iterative development process with emphasis on testing, in order to ensure maximum development effectiveness without unnecessary overhead. The subversion revision control system allowed for seamless collaboration among group members.

- User testing / Expert review
- Implemented in Java
- Subversion revision control
- Iterative development process
- Automated Testing

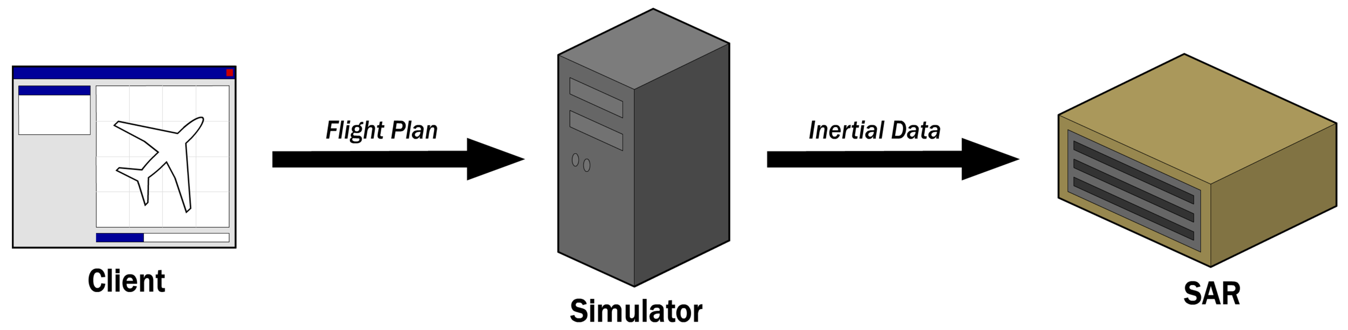



*Figure A: High Level Layout.*

## The Solution

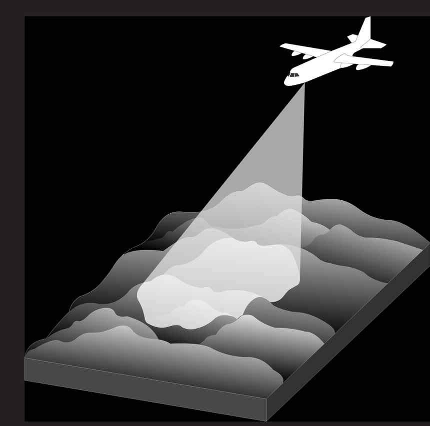
The application we developed employs a client-server architecture. This allows for the functionalities to be separated and for each component to reside on a different machine. The two components work in tandem to produce the inertial navigation data, which is then outputted to a SAR device (See Figure A). The application is modular, and interfaces between each module can be constructed to seamlessly allow for new clients and output devices to communicate with the server.

### Server Functionalities

- Remote communication
- Runtime flight plan changes
- Modular output
- Modular data rates

### Client Functionalities

- Waypoint list management
- Remotely controlled simulator
- Visual representation of flight path
- Saving waypoint list



## SAR Radar

Synthetic Aperture Radar (SAR) is a technology that produces high-resolution images of terrain over a broad area. The advantage of SAR imaging techniques over the photographic equivalent is that it is not inhibited by conditions like weather and time of day. To produce these images, an antenna, which emits a signal, is attached to the side of an aircraft. The time it takes this signal to be echoed back is used along with the inertial navigation data of the plane's movement to construct a single large image.

## The Problem

Since SAR is designed to be used on aircraft, testing a SAR unit potentially involves a flight dedicated to the test. This is both extraordinarily expensive and time-consuming. The alternative to this is to have a system that can replace the airplane - a device that can make the SAR unit believe that it is flying when it is in fact still on the ground. Such devices exist; however, they are proprietary, designed for particular hardware only, extremely expensive, inflexible, and difficult to upgrade or modify. A simpler and more elegant solution is needed, that uses simple software and standard hardware to provide an open, modular, and flexible solution.

## Acknowledgements

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