Signal Enhancement for Magnetic Navigation Challenge Problem

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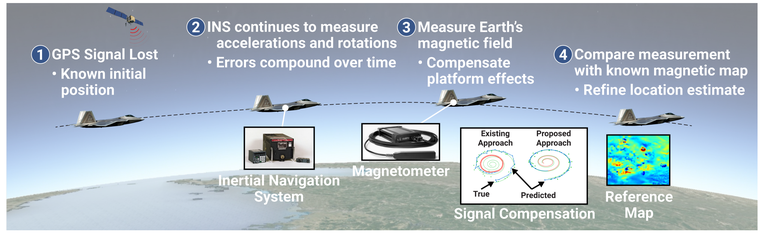
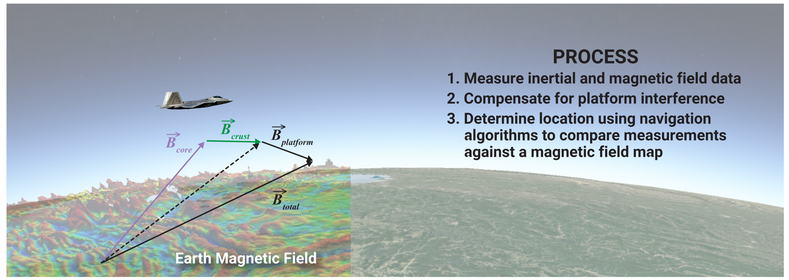
Motivation and Background

- Harnessing the magnetic field of the earth for navigation has shown promise as a viable alternative to other navigation systems
- A magnetic navigation system measures the magnetic field and uses magnetic anomaly maps to determine the current location
- This technique does not rely on satellites or other external communications, and is available globally, at all times, in all weather



Magnetic Platform Calibration

- The measured magnetic field includes core, crustal, and platform fields
- The crustal field used for navigation is a small component of the total field, and must be extracted



Advancing State of the Art

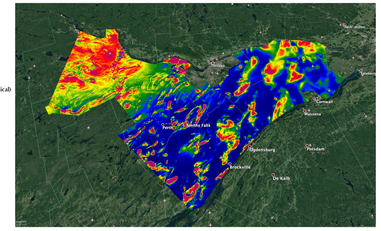
- Traditionally, the earth and aircraft fields can be separated using the Tolles-Lawson model
- Tolles-Lawson is effective in magnetically quiet environments such as the tail stinger of a geosurvey aircraft
- Compensating for platform interference in the noisy environment of an operational platform requires new techniques

	Geosurvey Aircraft	Operational Platform
Static Effects 1. Permanent Fields 2. Induced Fields 3. Eddy Currents	**Tolles-Lawson**	**Goal of Signal Enhancement for Magnetic Navigation Challenge**
Temporal Effects 1. DC Shifts 2. Communications equipment 3. Control surfaces 4. Fuel Pumps 5. Lights 6. Temperature Effects 7. Engine	**Magnetometer Standoff and Quiet Conditions**	

Aerial Data Collection

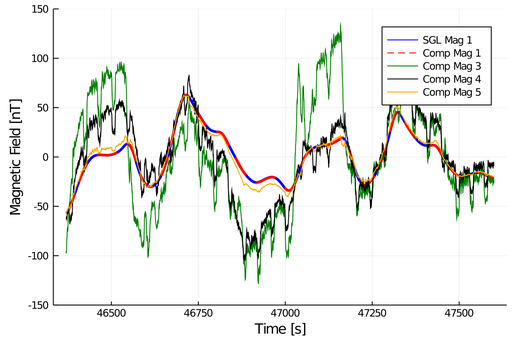
- Partner with Sander Geophysics Limited to conduct campaign to collect in-flight magnetic field data
- Magnetometers in various locations throughout aircraft in quiet (tail stinger) and noisy (cabin) environments

Sander Geophysics' Magnetic Gradiometer System



Baseline Results

- Tolles-Lawson adequately compensates the tail stinger magnetometer (Mag 1)
- Cabin-based magnetometers exhibit large levels of noise after traditional calibration



Challenge Problem

- Goal: Remove aircraft magnetic field to yield a clean magnetic signal for navigation
- Data: Magnetometers and supplemental sensors
- Truth signals: Tail stinger magnetometers with professional Tolles-Lawson calibration or magnetic anomaly map of flight region
- Evaluation metrics: RMSE compared to selected truth signal
- Interpretability and verifiability also of interest
- Full starter code available

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MIT-AI-Accelerator / **MagNav.jl**

Round	Start	End	Winning Team
1	26-Jul-20	28-Aug-20	Ling-Wei Kong, Cheng-Zhen Wang, and Ying-Cheng Lai Arizona State University (submission)
2	24-Sep-20	31-Jan-21	

https://github.com/MIT-AI-Accelerator/MagNav.jl

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