GPS/INS Integration with the iMAR-FSAS IMU

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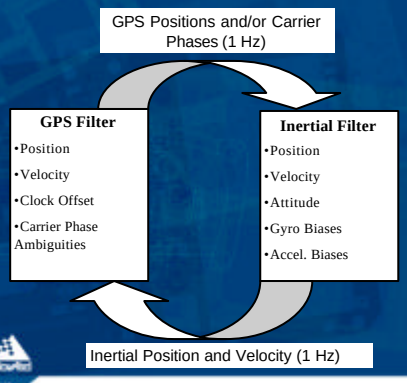
Outline

- GPS/INS Integration Architecture
  - SPAN Technology
  - Available IMU options
  - iMAR-FSAS
- Post-processing capabilities
- Test Description
- Test Results
- Summary

SPAN Technology

- GNSS receiver + IMU
- Tightly coupled
  - Access to receiver core
- Superior signal tracking ability
  - Fast re-acquisition of GNSS signals
- Extended Kalman Filter
  - Position, Delta Phase, and optional wheel sensor updates
- Optional lever arm modeling



SPAN IMU Choices

- Honeywell HG1700
  - AG11/AG58
  - AG17/AG62
- Northrop Grumman LN200
- iMAR iIMU-FSAS
  - German manufactured, subject to German export licensing
  - Equivalent to a tactical grade IMU, but designed for civilian markets
  - Optional integrated magnetic wheel sensor

Inertial Explorer Post-Processing

- An extension of GrafNav high precision GNSS processing software
- Loosely coupled GPS/INS integration
- Forward-Backward Smoother
- Wheel sensor aiding
- Supports most major GNSS manufacturer data formats
- Supports generic IMU data (when time tagged properly)

Test Description

- Three IMUs mounted in a land vehicle (mini-van)
  - iMAR iIMU-FSAS (with iMWS wheel sensor)
  - Tactical grade HG1700 AG11
  - Navigation grade Honeywell CIMU
- One GPS antenna split to all 3 systems
- Test loop driven under good GPS availability conditions
- Speeds of 50-110 km/hr
- Approximately 1.5 hours of data collection

Steady State Performance

- After SPAN filter convergence (~5 mins of dynamics)
- During full GPS availability
- Reference trajectory computed with CIMU data post-processed with Inertial Explorer
- RMS of the difference in the SPAN and CIMU trajectories considered the error of the SPAN system.

Steady State Performance: Position and Velocity

Position	SPAN with FSAS	SPAN with AG11
North	0.038 m	0.030 m
East	0.034 m	0.037 m
Height	0.033 m	0.030 m

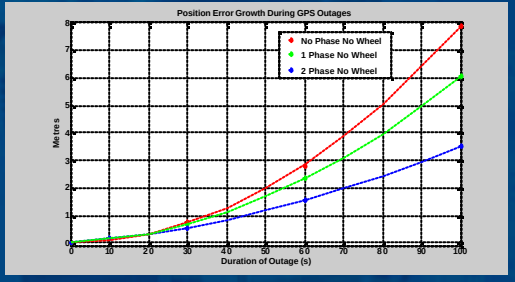
Velocity	SPAN with FSAS	SPAN with AG11
North	0.007 m/s	0.005 m/s
East	0.008 m/s	0.006 m/s
Height	0.005 m/s	0.007 m/s

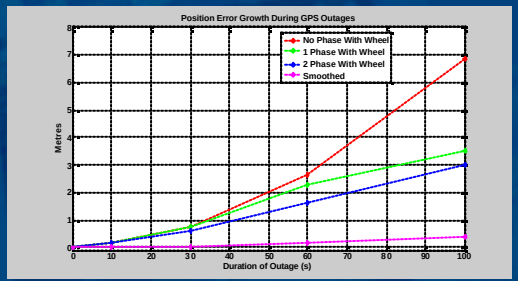
Steady State Performance: Attitude

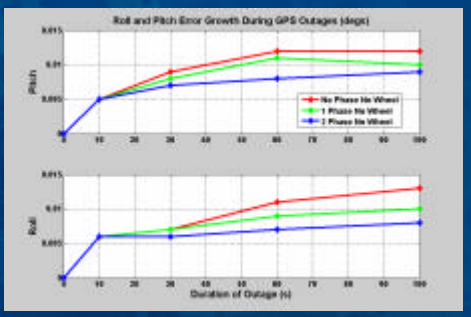
Attitude	SPAN with FSAS	SPAN with AG11
Roll	0.66 arcmin	0.66 arcmin
Pitch	0.84 arcmin	0.72 arcmin
Yaw	2.28 arcmin	1.86 arcmin

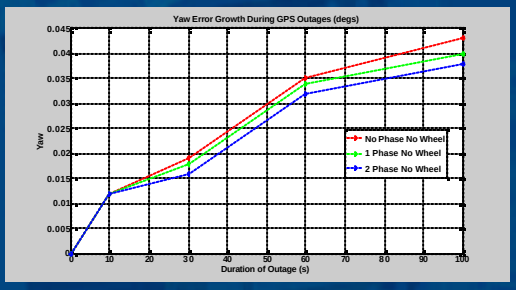
Error Growth During GPS Outages

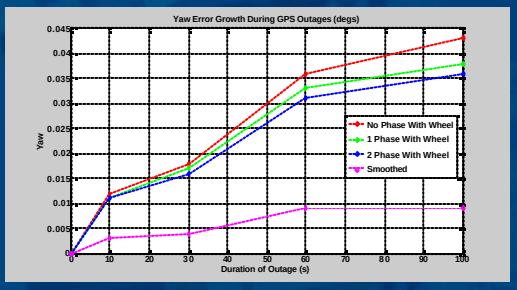
- Controlled GPS outages were applied to the data (offline)
  - Outages of 10, 30, 60 and 100 seconds in duration
  - 36 outages of each duration
  - 200 seconds of full GPS allowed between outages
- Complete GPS outages, and partial outages with 2-3 SVs used for phase updates
- Errors are assessed with respect to the full GPS trajectory











Summary

- iMAR iIMU-FSAS successfully integrated into SPAN
- German manufactured IMU
- Steady State iIMU-FSAS performance similar to HG1700 AG11 performance
- Ideal system for mapping applications

Questions?

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