Positioning and Navigation Solutions

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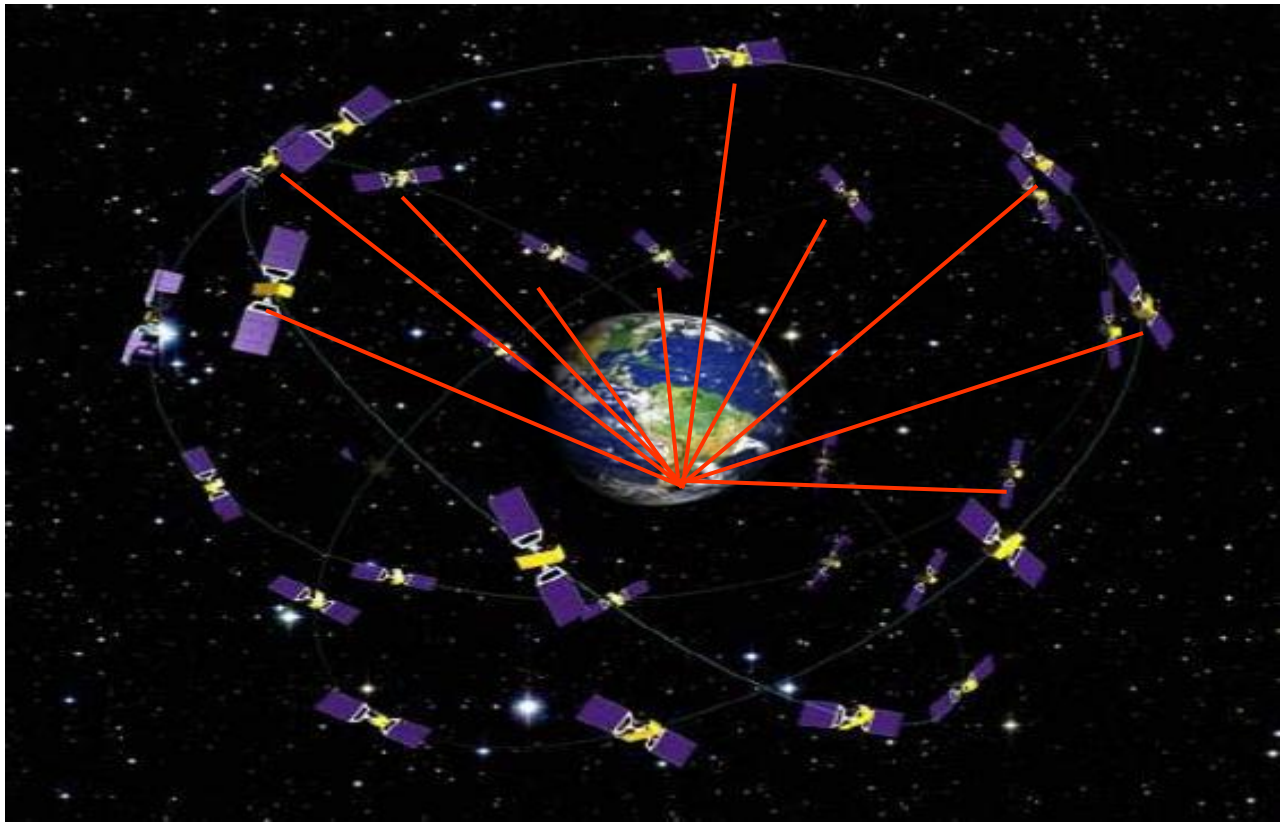
Global Navigation Satellite Systems (GNSS)

- NAVSTAR Global Positioning System (or simply GPS)
  - The best known operational system at the moment
  - Owned and funded by US Govt, operated by US Air Force
- GLONASS
  - Russian (originally military) system with global coverage
- Galileo
  - European civil controlled system, planned global coverage
- BeiDou
  - Chinese (originally military) system, planned global coverage
  - Developing very quickly
- Regional
  - Japan: QZSS, India: IRNSS

Basic GNSS Concept



How Accurate is GNSS?

10 m

1 m

1 cm

1 mm

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GNSS Accuracy

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UNITED KINGDOM · CHINA · MALAYSIA

Ordnance Survey

Ubiquitous Positioning

Multi-sensor, low-cost and robust positioning

- Based on single or multiple users
- Different types of platforms and sensors
- Autonomous or cooperative navigation

Seamless transition

- Different sensors, different platforms, different algorithms
- When transitioning between different environments
- *Plug-and-play* concept

Continuous positioning across all environments

- Open areas, partially obstructed, indoor

Transition Scenario

- 3 gyros and 3 accelerometers
- Orientation from integrating gyro output
- Displacement from:
  - Rotate measurements to Earth frame (using gyros),
  - Removing gravity and …
  - Double integrating accelerations
- MEMS are getting better
  - Cheaper (higher volumes - Wii, smartphones)
  - Better manufacturing
  - Calibration

Positioning & Navigation Technology

Positioning Sensor Fusion

- Clear synergy between GNSS and Inertial Navigation (INS)
- Focus has been on 'fixing' GNSS to provide continuity
- Tailored blend of sensors for particular scenarios

A New PNT Paradigm

- Consider INS as the primary navigational sensor
- Focus has to be on bounding the growth of INS error
- Flexible and adaptive blend with other sensors
- *'Plug and Play'*

Research Challenges

- Flexible software architecture
- Adaptive filtering and fusion of the data

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