Positioning and Navigation Solutions

Professor Terry Moore

Professor of Satellite Navigation
Nottingham Geospatial Institute
The University of Nottingham
• 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
How Accurate is GNSS?

1 mm
1 cm
10 m
1 m
GNSS Accuracy

Basic dGPS: 0.8-3m
RTK: 1-2cm
High Quality dGPS: 20-80cm
Standalone GPS: 5-10m
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
Inertial Navigation

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 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
Contact Details

Professor Terry Moore
Director of the NGI
Nottingham Geospatial Building
The University of Nottingham
Triumph Road
Nottingham
NG7 2TU

Telephone: +44 (0) 115 951 3886
Fax: +44 (0) 115 951 3881
Email: terry.moore@nottingham.ac.uk
WWW: www.nottingham.ac.uk/ngi