

# MUNICH GNSS SUMMIT 2012

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# OUTLINE

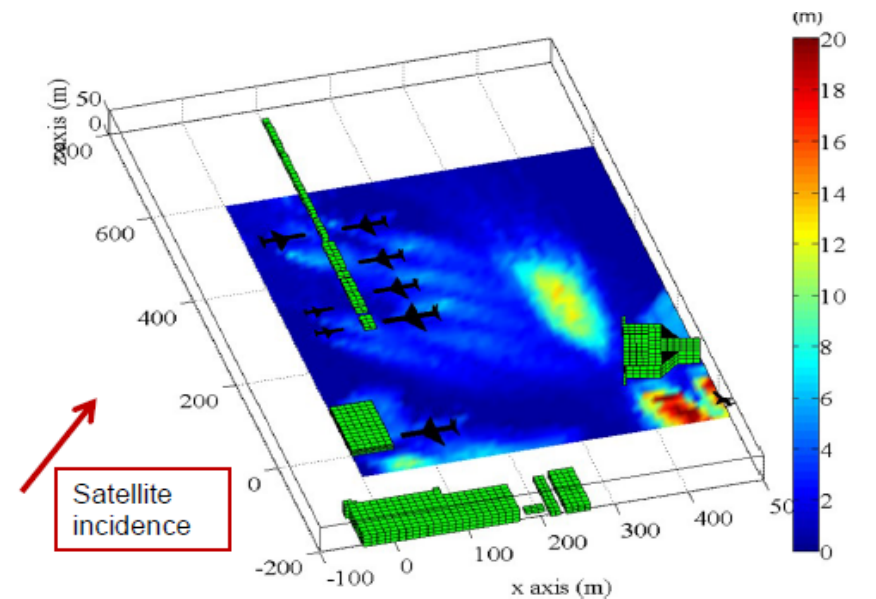
- 1. Current or upcoming operational benefits of satellite navigation to aviation
- 2. Multi-constellation navigation
- 3. Response to accidental and intentional radio frequency interference

# Benefits of GNSS to aviation

## • Upcoming interesting benefit

### – Airport surface operations:

- Main functions of SMGCS: Surveillance, Control, Routing and Guidance [ICAO, 2004]
- Requirements for guidance and steering to be adopted [Schuster and Bai, 2008], [Guilloton et al., 2011]
- The GNSS multipath for in flight [Murphy and Booth, 1999] is modeled, tentatively modeled on the airport [Jahn et al. 1996], [Brenner et al., 1998], [RTCA, 1998], [Chen, 2010]
- GNSS/INS sensors identified for localization [RTCA, 1998], but several other sensors were proposed: odometer [Sankrithi, 2004], camera [Konya, 2006], laser imaging, infrared sensors, RFID [Hutton, 2008]
- Nominal and faulty measurement models of new sensors have to be analyzed
- Hybridization of sensors for positioning and integrity monitoring [Larson et al., 2009]
- Final performance is not validated yet



Standard deviation of the predicted range error

# Multi-constellation navigation

- GNSS systems get more complex
  - Impact of anomalous iono (iono storms, scintillations) is reduced compared to GPS L1 C/A (more signal components, more frequencies, more constellations) but needs to be further analyzed [EUROCONTROL, 2010]
  - Multi-constellation combination techniques
    - Multiconstellation RAIM and ARAIM techniques need further analysis
    - Best combination technique at receiver level
    - Receiver design:
      - Antenna and RF design
      - Best strategy and best signal processing for acquisition and tracking
      - Best choice of pseudoranges combination for positioning

# Accidental and intentional RFI

- Low GNSS power can be a weakness against RFI
  - Intentional interference:
    - Most common form of intentional attack is jamming [Lo et al., 2009], using for example Personal Protection Devices (PPD)
    - Several cases of occurrences in airport areas [National PNT advisory board, 2010]
    - Can result in complete denial of service [Lo et al., 2009]
  - Intentional spoofing is difficult to address:
    - Characteristics are various [Papadimitratos and Jovanovic, 2008]
    - No occurrence model exists in the literature and the likelihood of such events is impossible to predict [Corrigan et al, 1999].
    - Robustness of current integrity monitoring techniques is not known

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