Navigation World Conference Forum

Session Indoornavigation

Chairman: Uwe-Carsten Fiebig

German Aerospace Center - Deutsches Zentrum für Luft- und Raumfahrt (DLR)
Institute of Communications and Navigation

Indoor Navigation

Motivation for indoor navigation

- Navigation has become a huge market for both
  - mass market applications
  - professional applications

Largest mass market GNSS application today is

- Car navigation

http://www.tomtom.com

Professional GNSS applications of great importance encompass:

- Fleet management / logistics

http://www.bvdp.de

Indoor Navigation

Motivation for indoor navigation

- Applications become more complex integrating different ways of transportation

- Car navigation
  - Driving through tunnels, using multi-storey car parks
  - Navigating from A to B includes “walking part”: leaving the car, going to an office

- Logistics applications include
  - Transport
  - Warehousing
  - Container tracking

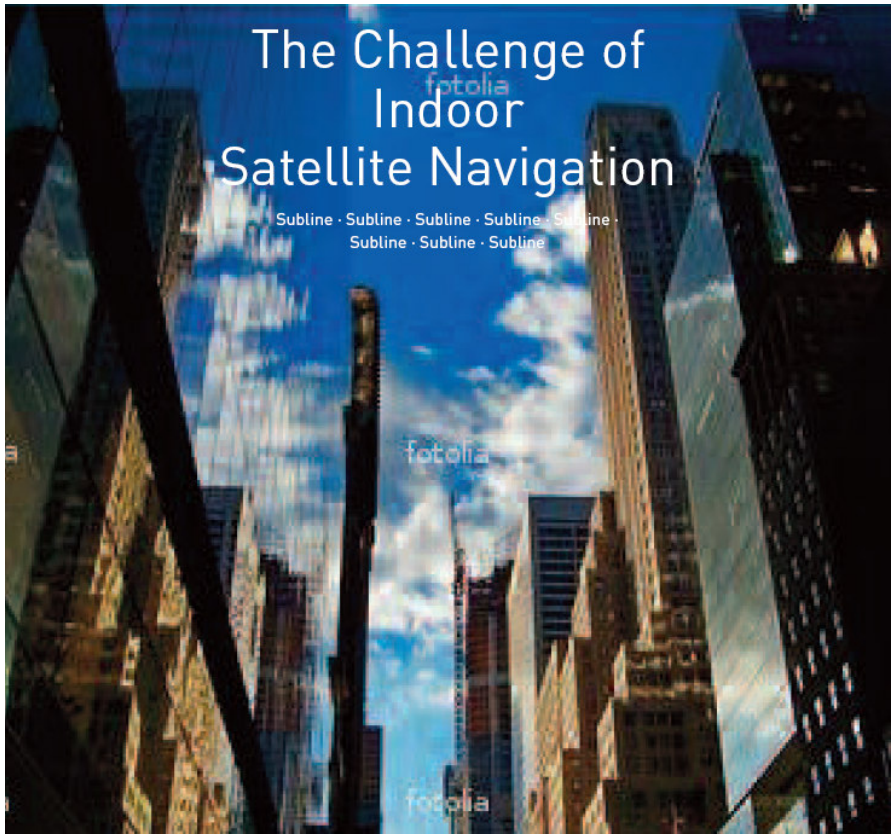
- Medical systems
- Robotics
- Security
- People and object tracking

Strong need for indoor navigation solutions

Indoor Navigation

Challenges

- In order to get a 3D position fix the satellite navigation receiver has to simultaneously receive signals from 4 different satellites
- Direct LOS (line-of-sight) between satellite and receiver is almost mandatory; otherwise
  - Shadowing disables signal reception
  - Reflected signals can cause severe positioning errors
- Satellite navigation has been designed for use in outdoor environments
- Satellite navigation is affected by severe accuracy degradations in indoor navigation not to say impossible to use.



Indoor Navigation

Solutions

There is no universal solution

(not today and even not on the horizon)

which fulfils all requirements of the various indoor applications

Indoor Navigation

Solutions

However, there are already promising solutions

(even today and also under development)

for specific indoor applications

Indoor Navigation

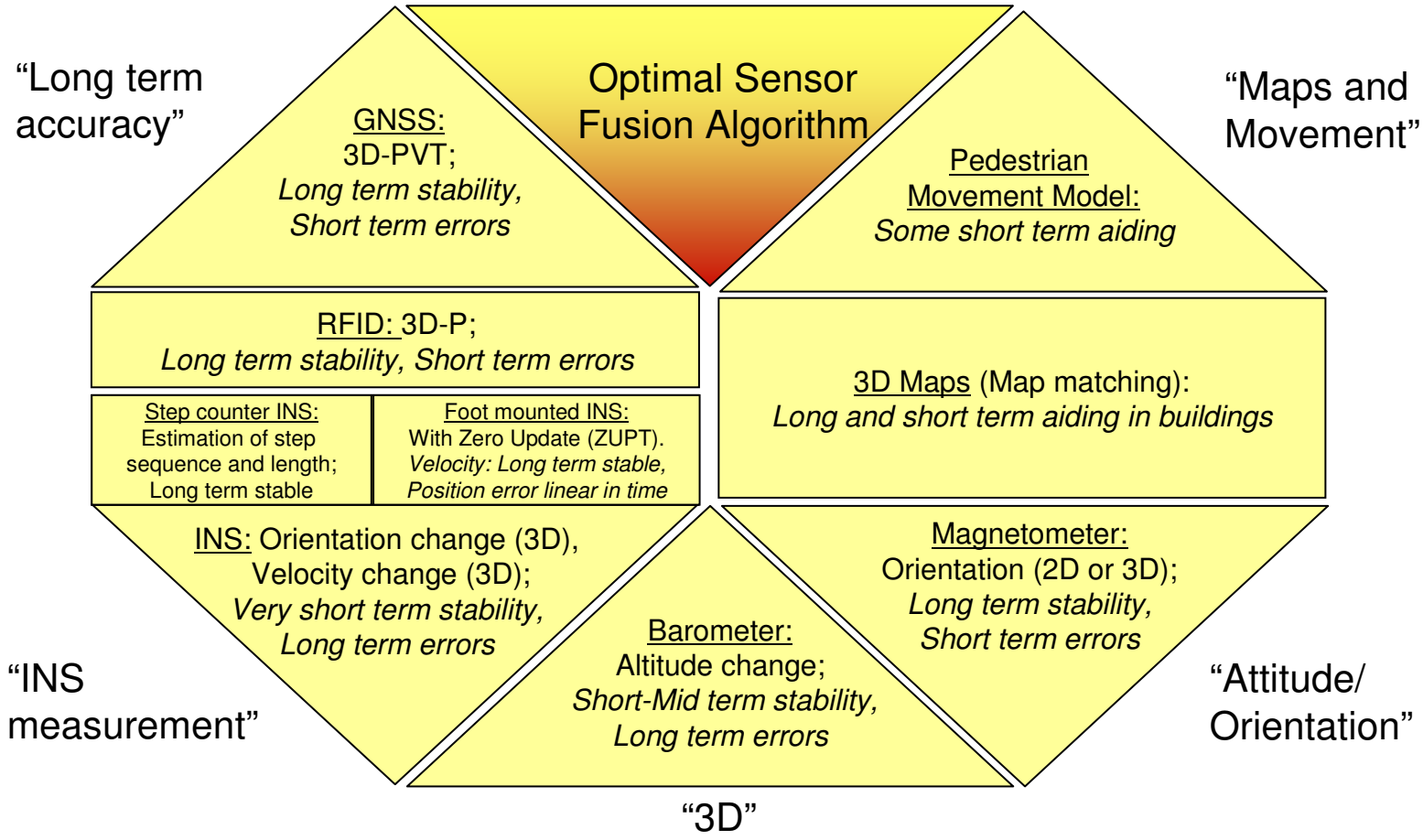
Solutions

- Solutions for indoor navigation encompass
  - High sensitivity GNSS receiver operating on signals with extremely low power level
  - Assisted GPS
  - Pseudolites
  - GPS and wheel sensors
  - Terrestrial mobile radio, WLAN, UWB
  - RFID Tags
  - Inertial system (with GNSS and other sensors)
  - Optical tracking systems
  - Etc…

  - (Seamless) sensor fusion shall be applied for various solutions

Indoor Navigation

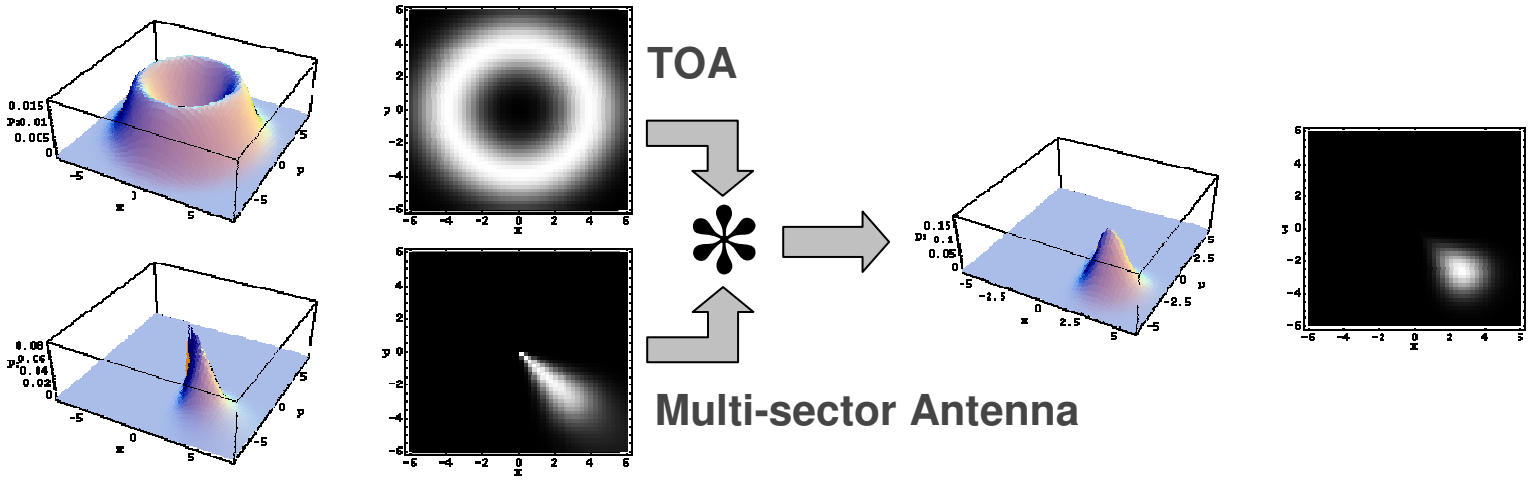
Sensor Fusion



Indoor Navigation

Sensor Fusion – Static scenario

- Combining sensors improves navigation

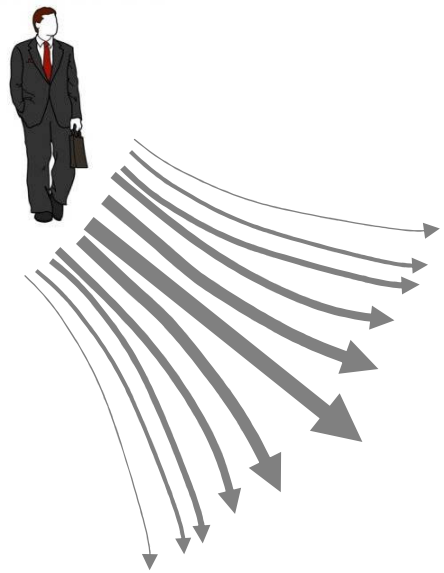


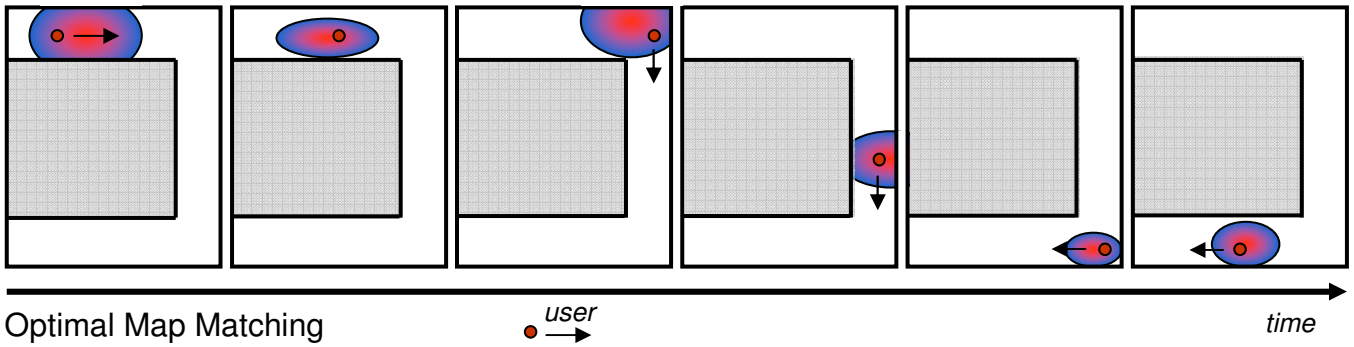
Reduced uncertainty

Indoor Navigation

Sensor Fusion – Dynamic scenario

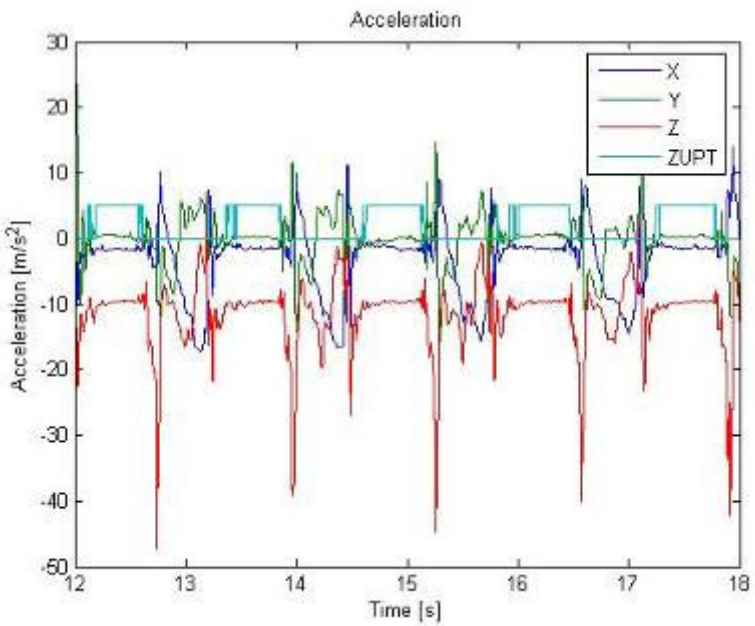
- Commonly the movement of a tracked person or object is limited by physical constraints, e.g. inertia, maximum speed, obstacles, walls
- Even if the exact movement is unknown it may be characterized by a random process, whose evolution is predictable with a specific uncertainty





Indoor Navigation

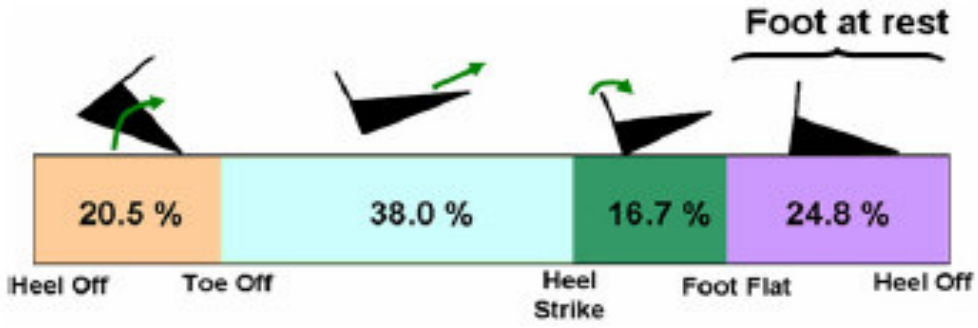
DLR's NavShoe: Inertial navigation for pedestrians principle



Acceleration Profile

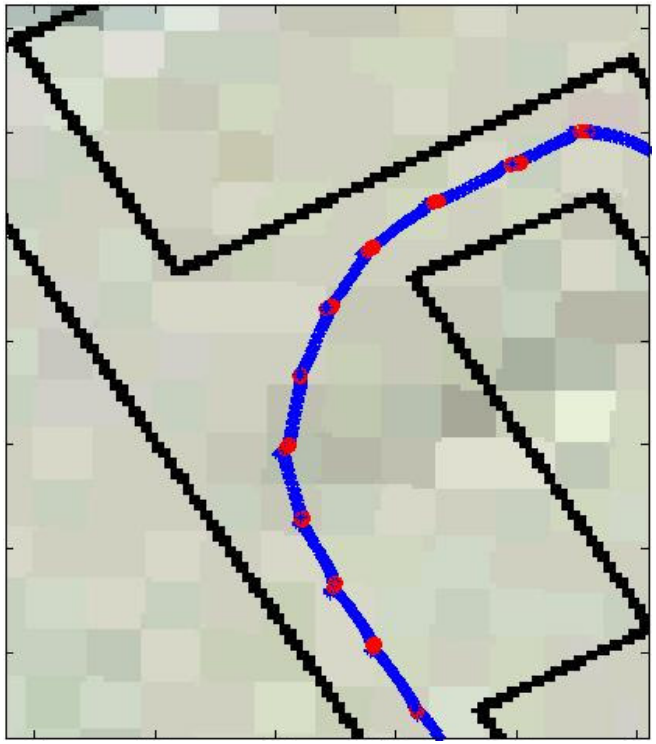
- Significant error reduction (from cubic to linear in time)

DLR real-time **NavShoe** prototype



Indoor Navigation

DLR's NavShoe: Performance



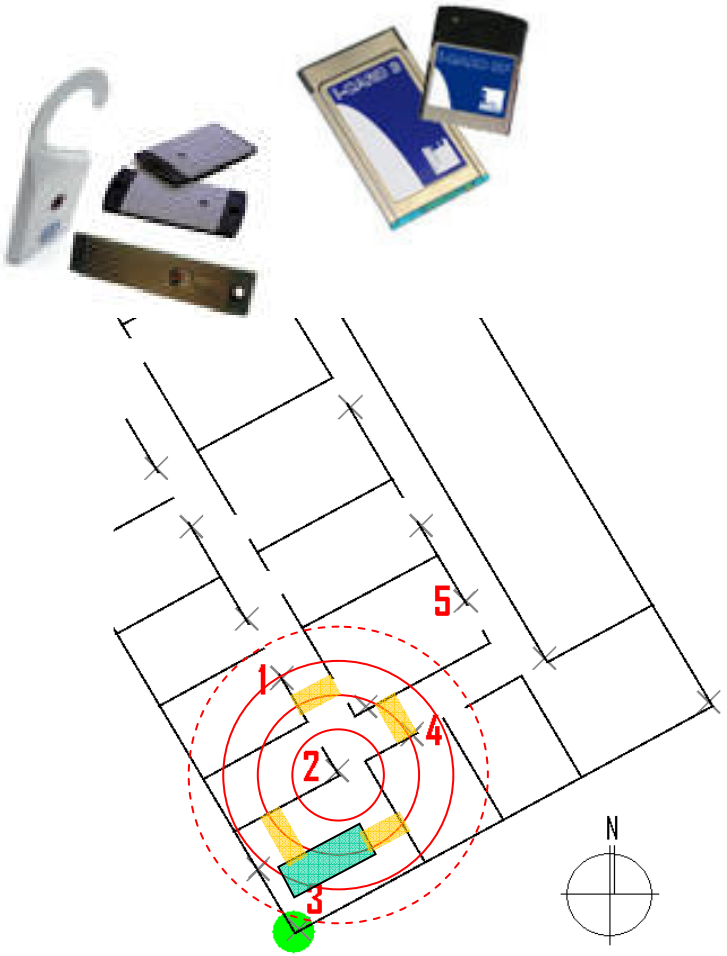
● Stride ● Rest phase

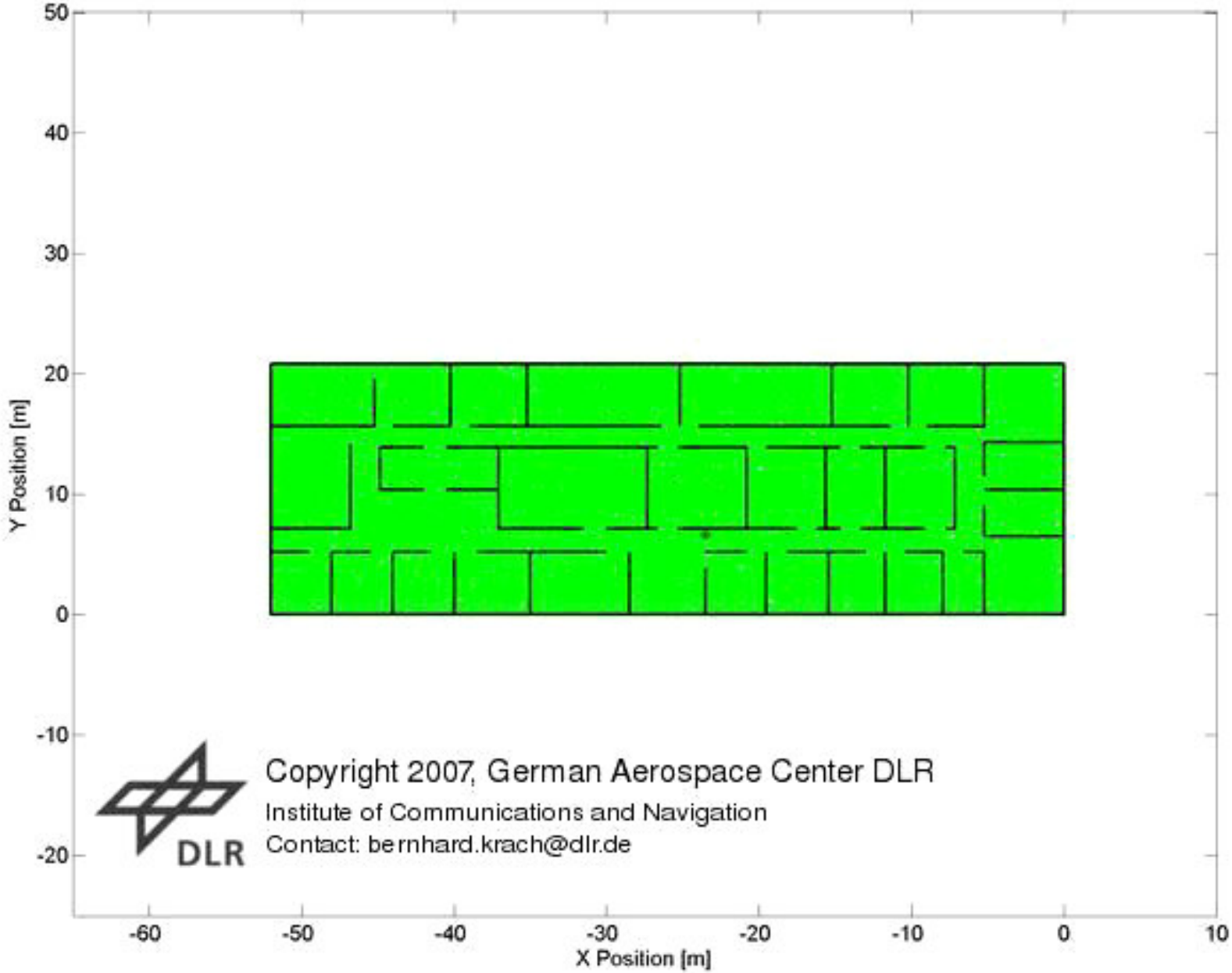
IKN building TE02

Indoor Navigation

Positioning via RFID

Measurements at DLR-IKN TE02 2nd floor

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Y Position [m]
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-20
-10
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X Position [m]
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Indoor Navigation

In this session we have 4 interesting presentations on indoor navigation:

- Erwin Löhnert / Elmar Wittmann, Ifen GmbH: INDOOR – Galileo/GPS Indoor Navigation & Positioning with Particular Respect to Security-Sensitive Applications
- Dr. Jaouhar Jemai, Ubisense AG: Indoor Localisation Based on UWB: Technology and Applications
- Moni Malek, eRide Europe GmbH: Indoor GPS - Applications of Assisted-GPS and Indoor position fixing
- Julius Rupf, T-Systems Enterprise Services GmbH: Indoor Localisation Services

The session concludes with a panel discussion