NAVKA - Navigation and Georeferencing Technologies for distributed GNSS/MEMS/MOEMS Sensors and Platforms

Challenge:

The expansion of GNSS, such as through Galileo and global positioning services, has made satellite positioning the driving force behind innovative navigation technologies. Here, the algorithmic fusion of GNSS data with Micro-Opto-Electro-Mechanical Systems (MOEMS) and Micro-Electro-Mechanical Systems (MEMS) sensors (fig. 1) is the only way to fully exploit the development and market potential at hand. In the face of the above challenges the NAVKA navigation algorithms (www.navka.de) have been developed in a new and general multisensor, multiplatform lever-arm design, and work optimally with the data of closely coupled and distributed GNSS/MEMS/MOEMS single sensors and platforms. The NAVKA navigation technologies at IAF/HSKA were awarded as Baden-Württemberg winner and on international level with bronze, among 434 competitors in the European Satellite Navigation Competition (ESNC) 2014, www.esnc.info/index.php?anzeige=bawue14.html .

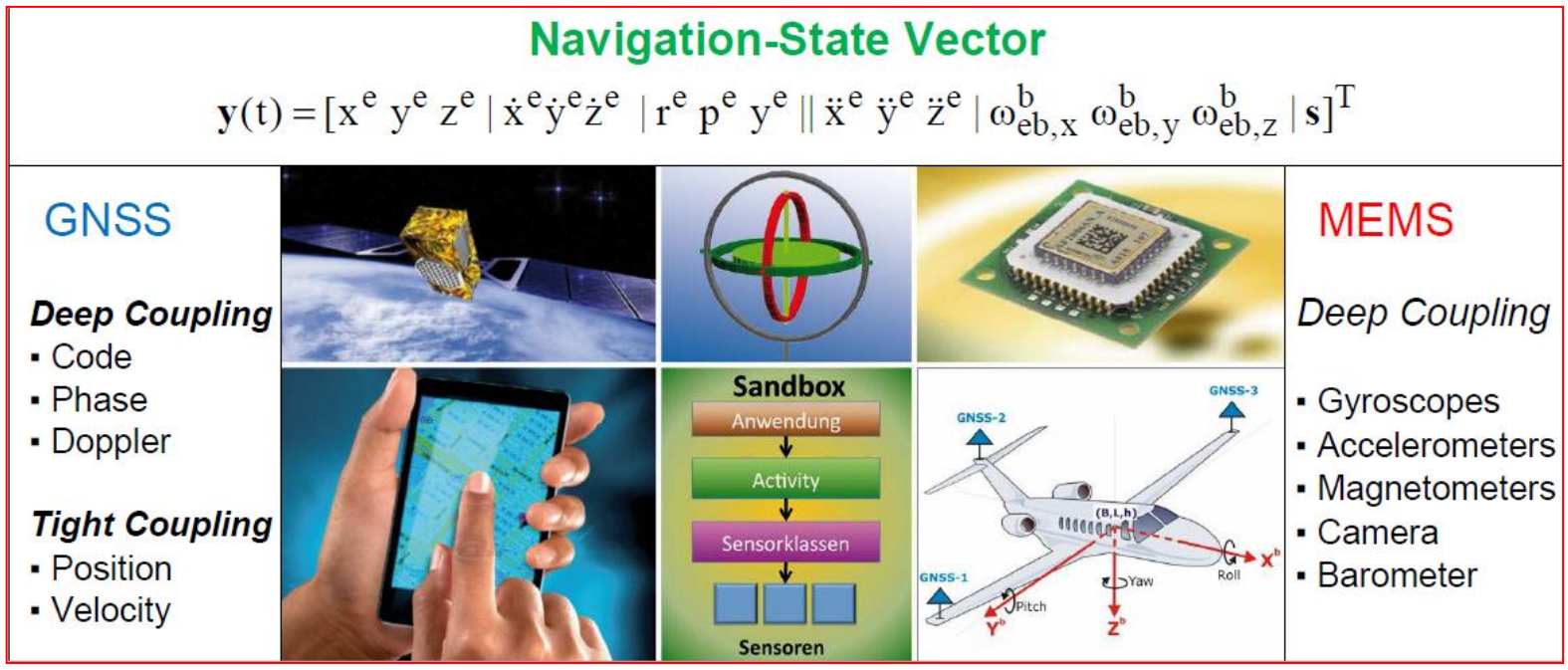

Fig.:1 NAVKA - GNSS/MEMS/MOEMS navigation technologies with distributed sensors and platforms for the navigation of vehicles, people and goods

The general concept of the further development of the NAVKA-algorithms and systems for distributed GNSS/MEMS/MOEMS and other optical sensors, is based on the estimation concept of the navigation state vector y(t) as a

- Robust general median estimation

$$\sum_{i=1}^{n} |\bar{v}_i| = \sum_{i=1}^{n} \left| C_\varepsilon^{-\frac{1}{2}} \cdot (l(y(t)) - l(t) \right| = \mathrm{Min}|_{y(t)},$$

instead of least squares and classical Kalman-filtering, In that way errors in the sensor data $l(y(t))$ are eliminated by the estimation principle itself.In general the above robust estimations of **y**(t), or **y**(t)-i in case of several sensor-networks, can be done by SIMPLEX-algorithms which have further advantages, e.g. the use of in-equations put upon on the navigation state, e.g. as an improved “map-matching” in autonomous car navigation, or in indoor-navigation.

Objectives of the project:

General objectives are the exploitation of the present NAVKA technologies, and their further development (algorithms, software, hardware and systems) in cooperation with different industry branches along the subsequently described three or more application areas. The following three innovative objectives and possible cooperation can directly start.

3. Out-/Indoor Mapping Systems for BIM and LOD4 Servers and Indoor-Navigation Clients Development

The running RaD project MSM (http://www.navka.de/index.php/en/overview-msm-en) aims to integrate the NAVKA algorithms, and sensor systems like NAVKArine-G1MC in respect to free-designable multisensor mapping platforms (e.g UAV, fig. 7) with other, typically laser scanners.

With the multisensory out-/and indoor mapping system MSM, the surrounding area can be captured in 3D. The self-referencing mapping system MSM is designed to work seamless outdoor/indoor. The integration of plenoptic (light field) cameras as an alternative to stereo cameras for visual odometry (VO) is a further and new MSM system component of the basic system

providing the reference trajectory. The fusion of GNSS/MEMS/MOEMS and camera data (fig. 3, below) with laser-scanner data leads to a high accurate SLAM trajectory **y**(t) for the final geo-referencing of the laser point-clouds and video image information.

All in all the MSM developments have the following technical and algorithmic features:

- Fusion of GNSS/MEMS/MOEMS and camera sensor data as provided e.g. by NAVKArine-G1MC as basic MSM system component
- Self-referencing based on the basic component with laser scanners by SLAM modelling of the final **y**(t).
- Post-processing the 3D SLAM-based laser point-clouds and georeferenced image information to a LOD 4 building model
- Technical realisation of the 3D mapping MSM prototype and its evaluation

The mapping system MSM, can be used for facility management, BIM, cultural heritage data acquisition (http://www.whittlespublishing.com/3D_Recording_Documentation_and_Management_of_Cultural_Heritage) and for LOD4 building generation.

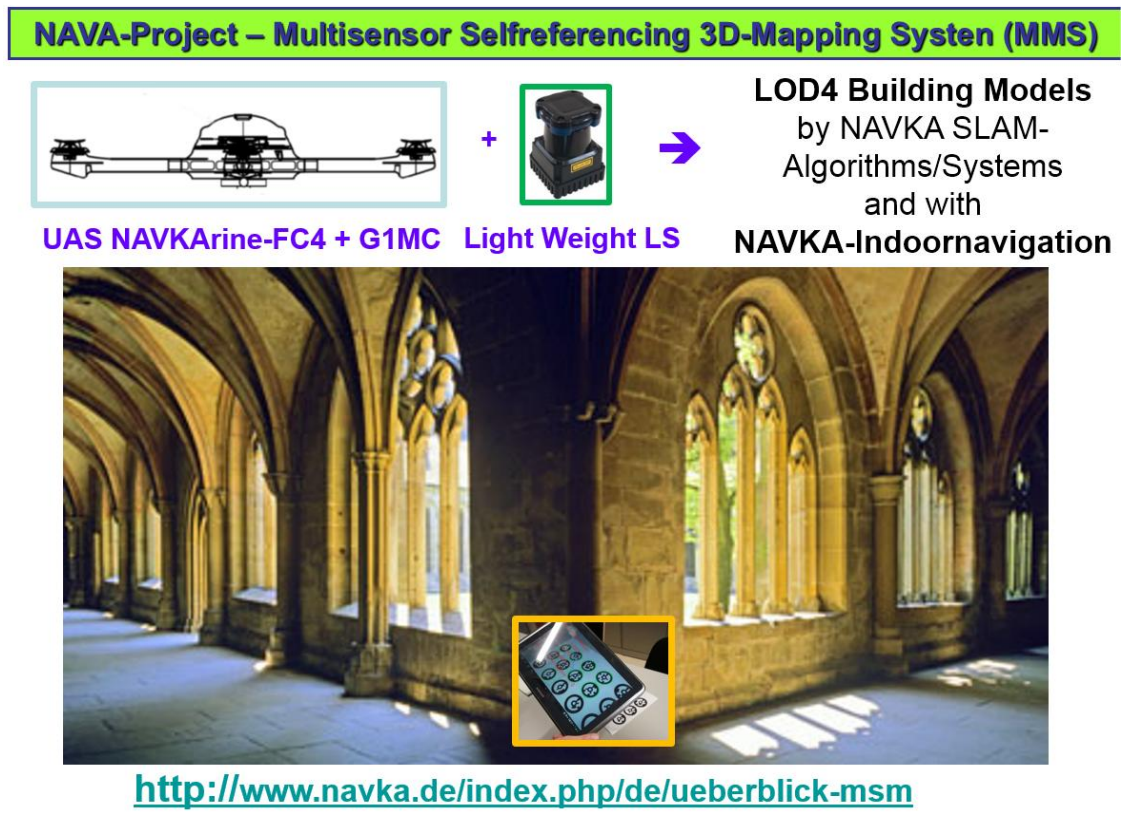

Fig. 7:

MSM system (above) put on a UAV platform for the generation of LOD4 building models for a use in indoor navigation with ubiquitous systems, like smartphones. The LOD4 model as georeferenced virtual marker space (NAVA concept and development)

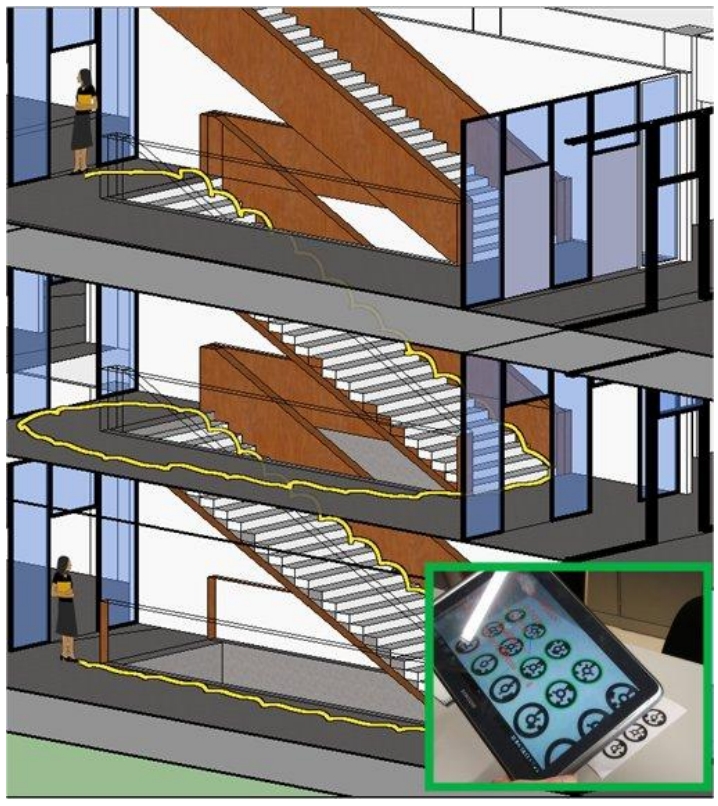

Fig. 8:

NAVKA developments on 3D-indoornavigation for SAR (left). Present developments by fusing MEMS, Visual odometry, real photogrammetric (right) or light markers, and the LOD4 model as virtual marker space.

LOD 4 building models can be put on a server, and sent by the provider to the smartphone clients - room or hall wise, and individually - for seamless out and indoor-navigation according to fig. 7 and fig. 8.

NAVKA (www.navka.de) developments on seamless GNSS/MEMS, optical sensors, and (real) markers based out/indoor navigation, see https://www.youtube.com/watch?v=FvesMeAF3HY .

Need for transnational cooperation:

The potentials have enough capacities for transnational cooperations

What kind of partners you are looking for? :

Cooperation partners from industry and research institutions, interested in NAVKA technology based developments on all kind of navigation and georeferencing systems for people, vehicles and good.

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