TECHNISCHE UNIVERSITÄT DRESDEN

AirMetro
Research Training Group
2947 at TU Dresden

T8: Ground-based Sensing

Geo-data-based multi-modal adaptive eVTOL navigation

Supervision: Hans-Gerd Maas, Anette Eltner

Motivation

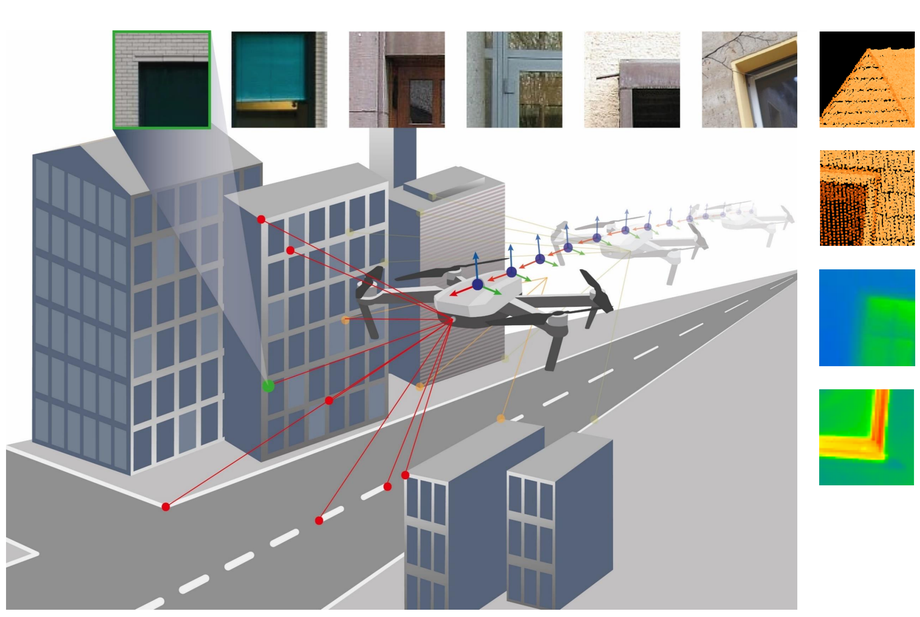
Precise and reliable Positioning and Navigation are essential requirements for a safe operation of AAM-aircraft.

Options:
- GNSS (Global Navigation Satellite Systems)
- INS (Inertial Navigation Systems)
- 5G/6G (mobile communication standard)
- Landmarks / control points

Limitations:
- Heterogeneous time-variant precision characteristics
- Signal or view obstructions
- Multipath effects
- Spatio-temporal variation of conditions

Methods

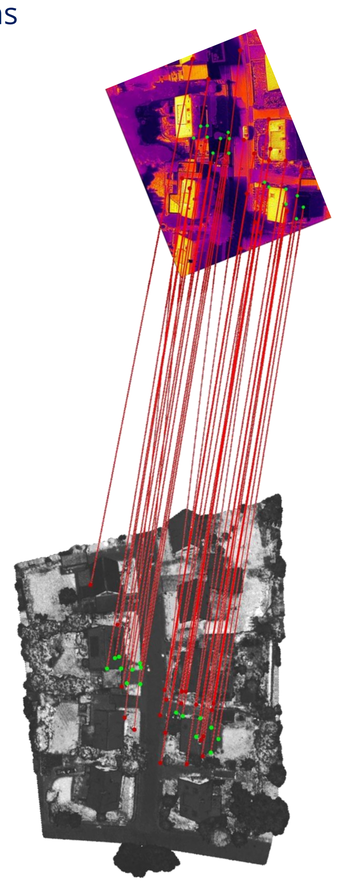
Adaptive fusion of navigation techniques:
- Variance component analysis
- Landmarks to support SLAM-based trajectory determination
- Machine Learning methods for landmark detection and matching on the basis of 3D city models and geodata
- Situative adaption of navigation processes
- Thermal cameras for person detection and navigation at night



Example: Multi-modal matching with SuperGlue [1]

Results

Precise and reliable position determination and navigation
- Situation-specific optimized sensor fusion [2]
- Catalogue of multi-modal point- and object-type landmarks on geodata basis → onboard processing on demand
- Georeferencing with internal precision and reliability measures
- Change detection → adaption of navigation decisions



Networking in the RTG

Input:
- T2: Models for situative adaption of navigation processes after constructive element changes
- T7: Micro-climatic data for navigation under challenging weather conditions
- T9: Communication technologies for flying in swarms or in densely settled areas

Output:
- T5: Landmarks for SLAM-approaches (georeferencing, compensation of drift effects)
- Postdoc project: Navigation data for traffic coordination
- T10: Real navigation data for digital twin consistency
- T4 and T6: Consideration of persons or vehicles in flight trajectories and landing areas

Literature:

[1] Elias, M.; Weitkamp, A.; Eltner, A.: Multi-modal image matching to colorize a SLAM based point cloud with arbitrary data from a thermal camera. ISPRS Open Journal of Photogrammetry and Remote Sensing. (accepted).

[2] Sardemann, H.; Blaskow, R.; Maas, H.-G.: Camera-Aided Orientation of Mobile Lidar Point Clouds Acquired from an Uncrewed Water Vehicle. Sensors, 23, 6009 (2023).

Network member in:

DRESDEN concept
SCIENCE AND INNOVATION CAMPUS

Fakulty of Environmental Sciences
Institute of Photogrammetry and Remote Sensing
UAV-Photogrammetry Center