Telematics International Mission - TIM

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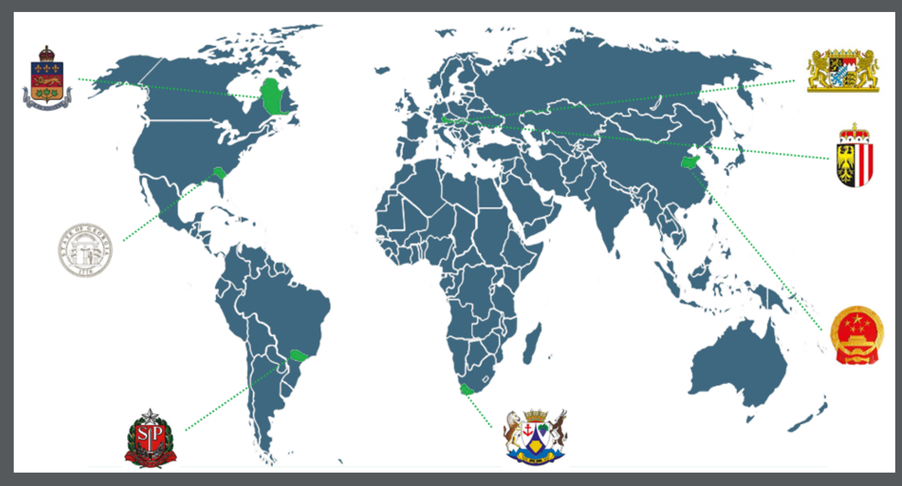

Objectives

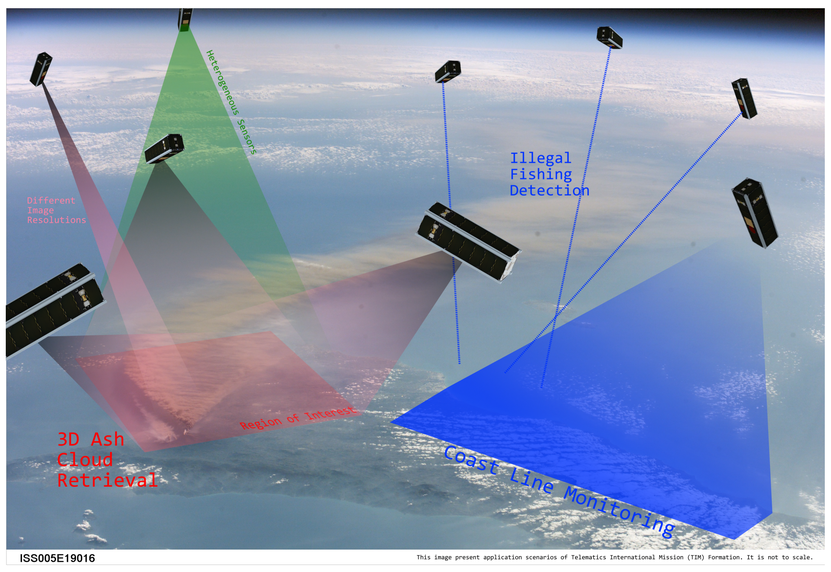

Figure 1: TIM formation & tasks

- Create formation of cooperating nanosatellites for joint Earth observation.
- Establish large formation to provide increased coverage and shorter revisit times for monitoring dynamic events.
- Present solutions to cutting edge problems: 1) monitoring of height of ash clouds, 2) identification of sea vessels, 3) monitoring of thermal anomalies.
- Unify infrastructure from all partners for one joint mission.
- Modular design based on UNISEC.

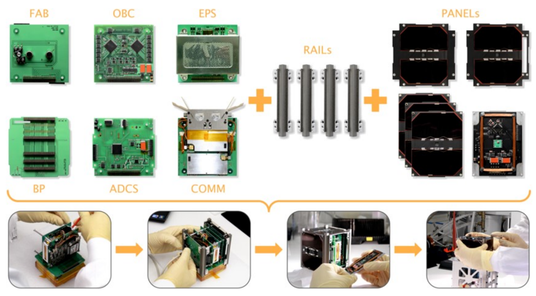

Figure 2: UNISEC reference implementation

Satellite Design

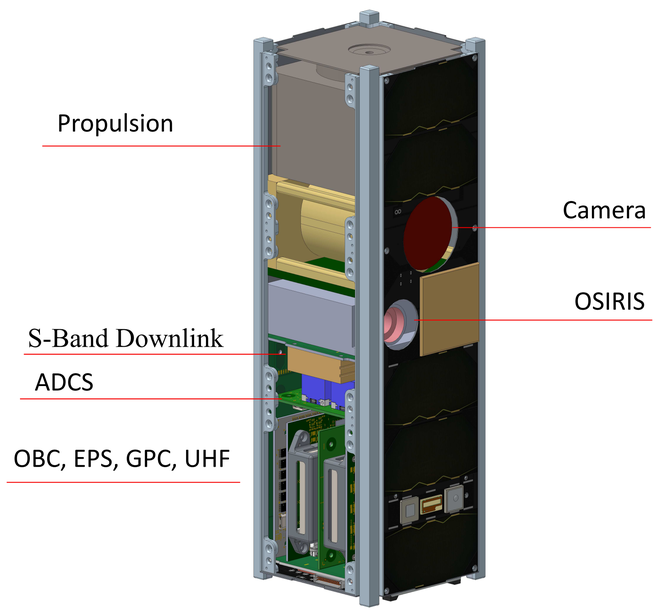

Figure 3: TOM Satellite Design

Coordinated Attitude Control

- Maximize overlapping area of images to ca. 80%.
- Stereo angle of ca. 10deg for photogrammetric measurements.
- Inter-satellite distances of ca. 100km.
- Required pointing accuracy of ca. 1deg achieved by newly developed miniature reaction wheels (Wittenstein/ZfT Development: 20x20x20mm, 20g; 2 mNms Momentum Storage, 0.1 mNm max. torque).

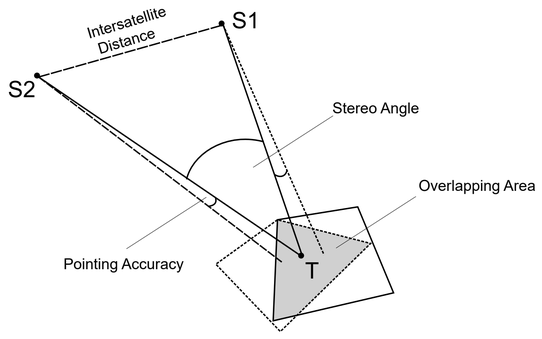

Figure 4: Concept of Coordinated Attitude Control

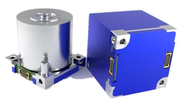

Figure 5: Reaction Wheels

Visual Servoing

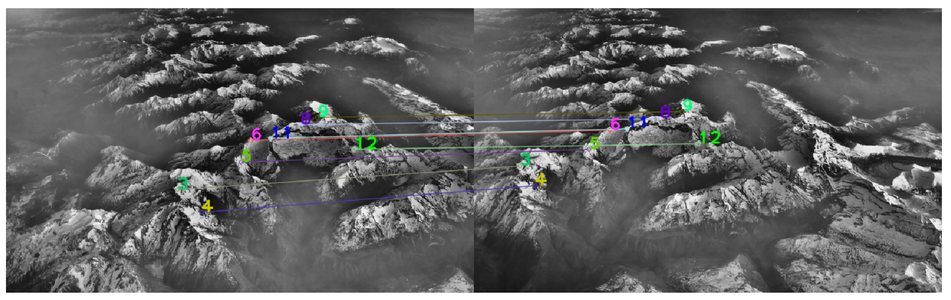

Figure 6: Example for a feature matching

- Satellites analyze area, process input, share data and provide input for attitude control to keep max. overlap of imaged areas.
- The method consists of three steps: (1) feature extraction, (2) description and (3) distributed matching.

Formation Control

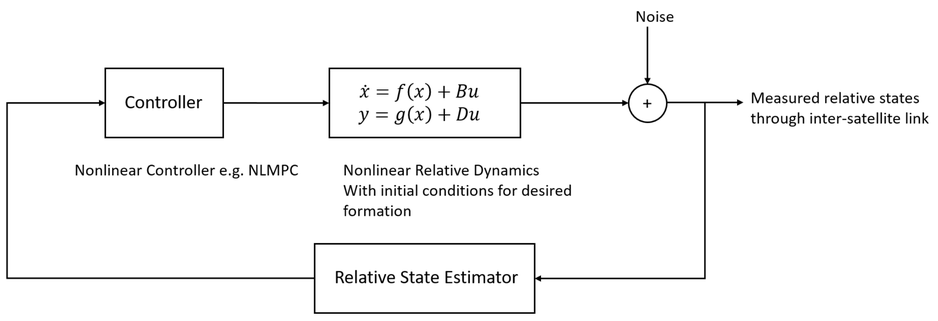

Figure 7: Formation control for desired formation configuration

- Natural dynamics utilized for formation design.
- Projected circular orbit and in-track formation for Earth Observation.
- Traditional linear models for relative motion not sufficient here. Nonlinear control techniques need to be employed.

Communication

- Space Segment
  - ▷ UHF : Telemetry and low speed data transfer, ISL communication.
  - ▷ S-Band : high speed downlink.
  - ▷ OSIRIS : Experimental optical downlink.
- Ground Station Network
  - ▷ Provides interface for heterogeneous software and hardware systems.
  - ▷ Scheduling algorithms of available stations across the network.

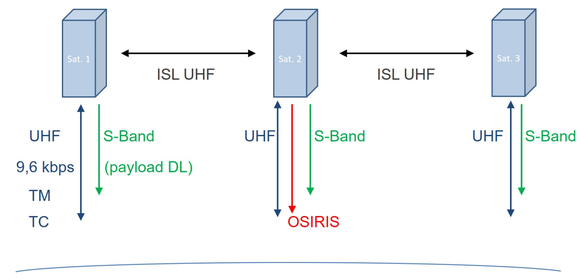

Figure 8: TIM communication concept

Testing facilities

Figure 9: Turntables at ZfT

- Simulation of Dynamic Observation.
- Geometries for Camera Testing.
- Sensor calibration.

Acknowledgments

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