13 Nov 2014, Seminar on UAV-based remote sensing in fluvial research

UAV – Technologies and opportunities

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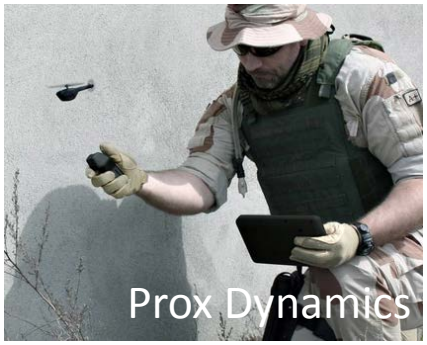
Outline

- UAVs
- Selected technologies
- AMOS and UAV-lab
- Selected applications and opportunities

Unmanned Aerial Vehicles (UAVs)

Microhelicopter

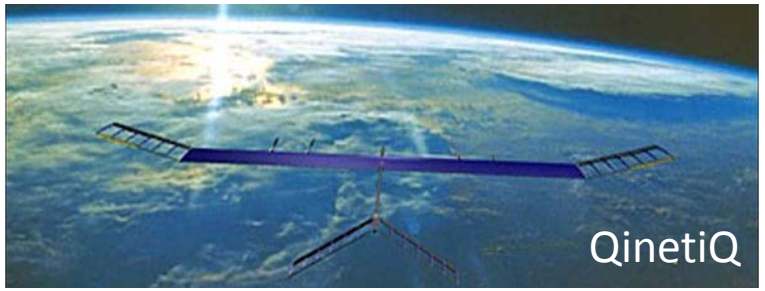


Helicopter

Fixed wing

Multirotor

Endurance

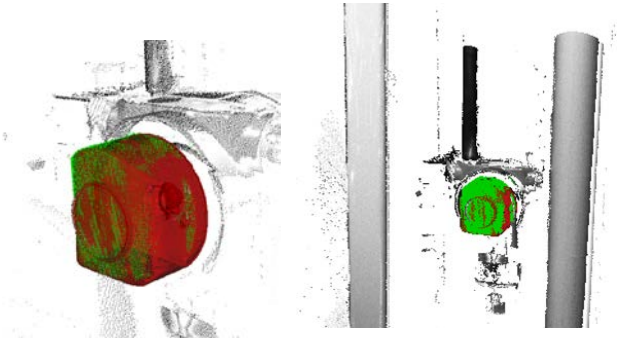


Air balloon

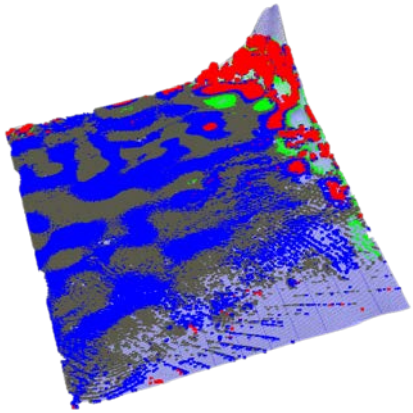
Other terms: RPAS, UAS

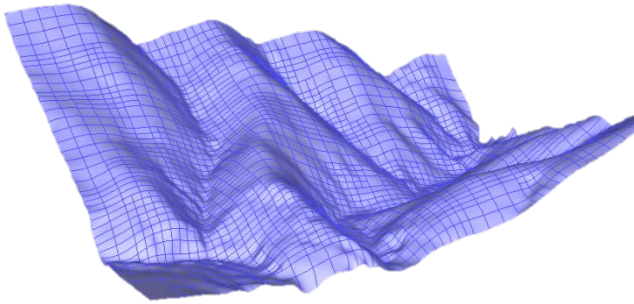
Selected technologies

Generation, handling and analysis of large 3D data



- Scanning technologies
  - Synthetic aperture radar, Lidar, optical imaging, …
- Compact representation of geospatial information: LR B-splines
  - Patented method by SINTEF
- Selected uses for the technology
  - Accurate representation existing structures
  - Improved quality of registration of senor data (LIDAR)
  - Feature extraction
  - Change detection
  - Compact representation of the safe zone for UAV movement

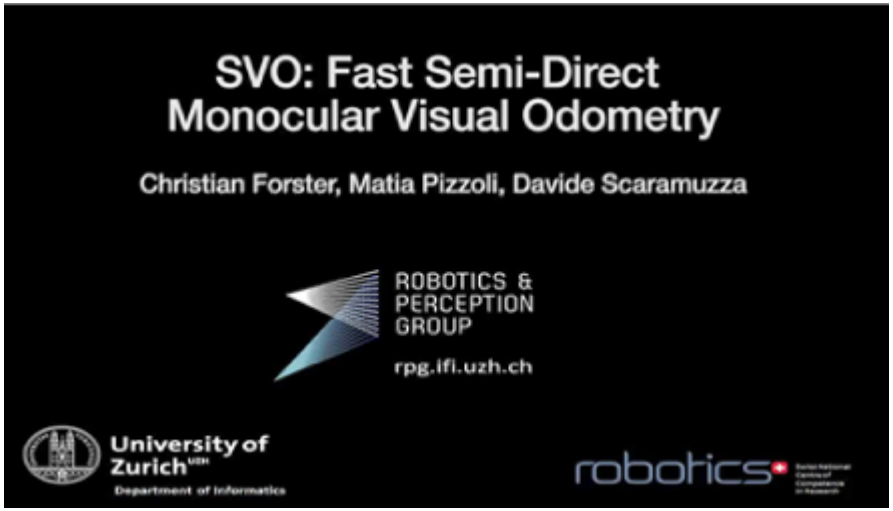




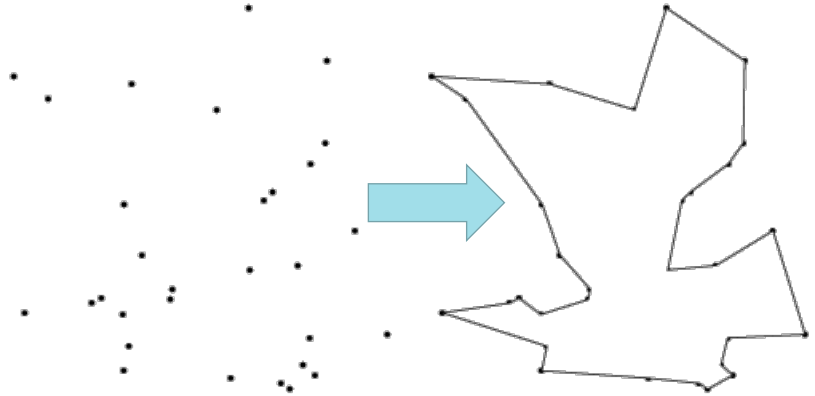
Localization (Robot: "where am I?")

- SINTEF localization system – **scalable according to requirements on cost and precision**
  - Modularity – sensors and filtering technologies
  - Scalability – cost, #sensors, etc.

- Localization in (partially) GPS-denied areas



Autonomous planning



- Route planning
  - "travelling salesman"
- Path-planning with collision avoidance
- State-of-the-art GPU implementations
  - Faster processing

NTNU

DNV·GL

Statoil

MARINTEK

SINTEF

AMOS (Autonomous Marine Operations and Systems)

NTNU UAV-lab

NTNU, Dept. Eng. Cybernetics
Prof. Thor Inge Fossen
Prof. Tor Arne Johansen

Five focused main research areas

1. Smart UAV remote sensing payloads - Autonomous detection, classification and tracking of objects and distributed features
2. UAV payloads for deployment and recovery, e.g. of ground/floating sensor nodes from UAV
3. Multi-vehicle networking – mobile sensor network
4. Fault-tolerant and robust UAV navigation
5. Enabling ship-based UAV operations in remote and harsh conditions

NTNU UAV-Lab

Procurement and operation license from Norwegian CAA (Civil Aviation Authority / Luftfartstilsynet) since 2014

- Penguin B fixed-wing (VLOS/EVLOS/BLOS)

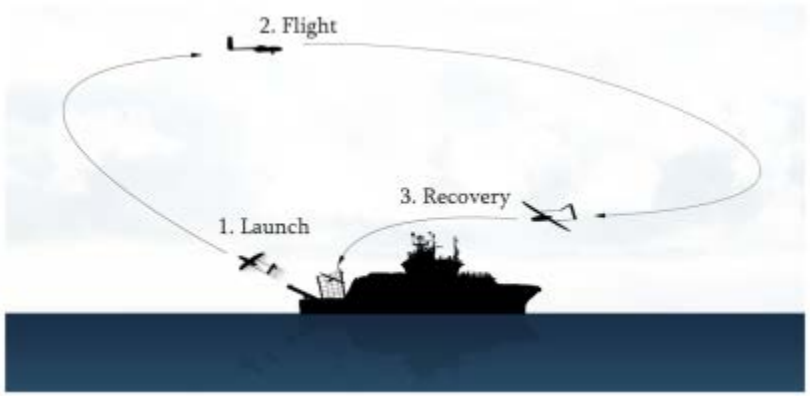
- 3D Robotics hexa-copters (VLOS)

- Microdrone quadro-copter (VLOS)

- X8 fixed-wing (VLOS)

Launch and Recovery Systems

- Conventional take-off and landing on airfields
- Catapult and automatic landing in net onboard the NTNU ship Gunnerus



Selected applications and opportunities

Background

- NIFS (priority programme between Directorate of Public Roads, Norwegian National Rail Administration and Norwegian Water Resources and Energy Directorate) has initiated an identification of experiences and potential applications using drone technology within natural hazards and infrastructure

UAVs for surveillance of danger of a landslide

- Purpose: Give faster grounds for decision-making for when to reopen the road after a landslide
- Test project executed in a collaboration between Vegdirektoratet and Høgskolen i Sør-Trøndelag
- Preliminary results were promising: pictures taken from the drone were very good according to Vegdirektoratet

Flood support

- A flood in Colorado, USA, in 2013 made it difficult for conventional manned airplanes and helicopter to get in and out of the area
- Falcon, a company producing drones, used these equipped with a GPS receiver and a camera to survey the damages wrought by the flood
- The mission had to be aborted due to missing approval for the given situation

- Purpose of the mission:
  - Identify the ability to navigate for emergency response vehicles
  - Identify isolated households
  - Assessment for damage repair

Visual inspection related to electric power production

- Hålogaland Kraft have used drones for visual inspection of infrastructure for almost one year
- Application areas this far – Inspection of:
  - power lines (constitute ca. 50 % of drone related activity)
  - pipelines – external inspection for leakages)
  - switchgears in connection with high-voltage
  - ice conditions in dams
  - images in connection with lisence applications
- Have operated in rain, snow and wind (up to strong breeze)
- Find that the quality of the inspection data is very good

Trade seminar: Drone technology for natural disasters and infrastructure

Where?	• Radisson Blu **Royal Garden Hotel**, **Trondheim**
When?	• **13. januar 2015** – keep the date ☺

- Focus: Presentations and debate with relevant participants from the value chain within drone technology, natural disasters and infrastructure

- Selected presenters:
  - Erfaringer og framtidsutsikter fra Luftfartstilsynet – en premissgiver for dronebruk, Morten Raustein, Luftfartstilsynet
  - Erfaringer og framtidsutsikter etter 1 års operasjonell dronebruk i Hålogaland Kraft, Lars Sletten, Hålogaland Kraft
  - Experiences, possibilities and outlook: RPAS for industrial inspection and land surveying, NN, Cyberhawk
  - Resultat fra kartlegging av erfaringer og potensial for droneteknologi, Esten I. Grøtli, SINTEF
  - Fjernmåling av snø og is ved bruk av sensordrone, Rune Storvold, NORUT