Change Detection for Autonomous Cars

When a vehicle navigates continuously within a certain area, exploiting its previous map to localize robustly within it and pre-plan its actions leads to optimized performance. For this process to be reliable, spatio-temporal change detection has to take place. However, change detection is challenging both in terms of correlating the input data and maps, as well as in terms of map scalability.

Research Tasks:

- Task 1: Change detection in pose-annotated images
- Task 2: Volumetric mapping
- Task 3: Change detection in volumetric maps
- Task 4: Semantic change classification using convolutional neural nets
- Task 5: Dataset collection and groundtruthing Task 5: Field experiments and evaluation

How to start:

- Approach 1: Work on pre-recorded visual data provided by the Autonomous Robots Lab and initiate your efforts with detecting change within them. As a preliminary step take some camera frames in fixed environments that you impose change and then aim to detect from varying viewpoints.
- Approach 2: Use a miniature robot to develop the overall change detection pipeline. Progressively evaluate it on this platform and subsequently test it on camera frames taken by the real vehicle (datasets provided by the lab).
- Approach 1+2: Once change detection in images has been achieved robustify the algorithm to eliminate nuisance change detection (e.g. change of light).
- Approach 1+2: Given the above proceed with 3D change detection by employing volumetric mapping data on bus datasets.

Team Meeting Time:

- Team 1:
- Team 2:

Robotic Inspection of Mines

Mine inspection corresponds to a major challenge due to the difficult environments and the often visually-degraded conditions. This project refers to the development of an aerial and ground robotic system that aims to enable systematic 3D mapping and semantic classification.

Research Tasks:

- Task 1: Platform development (ideally based on existing robots at the lab)
- Task 2: Volumetric and surface mapping
- Task 3: Aerial - to -ground robot collaboration
- Task 4: Dataset collection and groundtruthing
- Task 5: Field experiments and evaluation

How to start:

- Decide between aerial or ground robotics solution.
- Work with people of the Autonomous Robots Lab to assemble your robot prototype and enable its baseline control.
- Conduct literature review on what is required specifically in the mine inspection process and particularly underground. What do they need to monitor. What level of detail is required.
- Collect aerial robotic datasets to conduct 3D mapping (initially offline and then in real-time) and perform volumetric calculations in it.
- Perform field experiment in a mine or a mine-analog environment (e.g. a tunnel).

Team Meeting Time

- Team 1:
- Team 2:

MineBots

Robotics for conducting work related to the mining task are expected to revolutionize this historic but persistently important industry of major capitalization. This project aims to develop a miniaturized autonomous system that conducts excavation work on its own.

Research Tasks:

- Task 1: Platform development
- Task 2: Integration of Sensing and Processing capabilities
- Task 3: Development of control strategy for automated excavation.
- Task 4: Development of sensing solution to detect soil and the point to grasp.
- Task 5: Experiments in miniature mock-up at the lab.

How to start:

- Work with people of the Autonomous Robots Lab to define the robotic platform and its building process. Integrate a 2-camera system on the main body of the excavator and close to the end-effector.
- Conduct literature review robotic manipulation and understand – formulate the excavation process.
- Develop the control and sensing strategy.
- Perform experiments in a mock-up as early as possible to allow iterative improvements.

Team Meeting Time

- Team 1:
- Team 2: