

Master's, Bachelor's and Project Theses in the Field of: **Perception and Consensus in Multi-Robot Systems**

Topic Description

Heterogeneous mobile multi-robot systems combine different platforms, sensors and viewpoints. They can explore large or hard-to-access environments in parallel, cross-check measurements and compensate for individual sensor failures. One example is humanitarian demining, i.e., the removal of explosive landmines, where suspicious objects can be assessed from several perspectives without endangering humans.

Consensus means a shared team decision based on local observations, detections, confidence values, uncertainties and pose information. The task becomes difficult when images are blurred, noisy, shadowed or occluded, when viewpoints are unfavorable, sensors fail or individual robots report conflicting observations.



Research Tasks

Possible theses investigate existing consensus algorithms and fusion strategies for visual perception tasks and improve them. Topics include landmine or object detection, multi-view fusion, uncertainty estimation, detection of disagreement within the team and strategies for requesting additional observations.

An experimental pipeline may combine image data, synthetic disturbances such as blur, noise, shadows, occlusions or compression, and a small simulation of cooperative decision-making. Depending on prior knowledge, data availability and planned duration, the thesis may focus on computer vision, robotics, probabilistic fusion or trustworthy AI.

- 1) **Robust perception:** quantify the influence of image disturbances and occlusions on detection, classification and uncertainty.
- 2) **Consensus methods:** compare and improve voting, Bayesian, graph-based or learned fusion strategies.

Requirements

- Interest in robotics, computer vision and cooperative autonomous systems
- Python/PyTorch experience; knowledge of image processing or object detection is beneficial
- Experience with simulation, uncertainty estimation or model evaluation would be beneficial

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Start

by arrangement