Multi-modal SLAM for Fixed-wing UAVs

Abstract: Simultaneous Localization And Mapping (SLAM) is now a mature technological field. Nevertheless the majority of the methods are tailored to low-speed aerial, ground or underwater robots. Limited work has been conducted focusing on high-speed fixed-wing Unmanned Aerial Vehicle (UAV) navigation especially when this is about flying very close to terrain or within clutter (e.g., inside a forest or within urban zones). This project aims to build upon ARL's Unified Autonomy Stack - and especially our Multi-modal SLAM system - in order to develop a Vision-LiDAR-Radar-IMU fusion system for resilient SLAM in high-speed fixed-wing flight.

Relevant Projects: Norwegian Centre for Embodied AI, SPEAR

Activity as part of ARL's Unified Autonomy Stack research (https://ntnu-arl.github.io/unified_autonomy_stack/).

Tasks:

- Review state-of-the-art SLAM approaches for high-speed and fixed-wing UAVs.
- Analyze limitations of existing visual-inertial and LiDAR-based SLAM under aggressive flight conditions.
- Extend ARL's Multi-modal SLAM framework to incorporate radar sensing alongside vision, LiDAR, and IMU.
- Design and implement sensor fusion strategies for robustness to high سرعت, motion blur, and perceptual degradation.
- Integrate the proposed system within the **Unified Autonomy Stack**.
- Evaluate performance in simulation and (if possible) real-world flight experiments in cluttered environments.

Literature (indicative):

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