Autonomous Docking for an Aerial and Legged Marsupial System

Abstract: Aerial robots are unconstrained by terrain, but they present limited endurance. Heterogeneous robot teams offer significant advantages for exploration and navigation missions in unknown environments. Notably, the air–ground robot teams have superior efficiency due to their mixed abilities and shared sensor resources, which is extremely useful when completing missions. However, the high energy consumption and reduced payload capability of the aerial platforms limit the complete robot team's behaviour. At some point in a mission, the aircraft must return to the base, land, and replenish its batteries. This task restricts the team from exploring the environment in-depth and working for even longer durations. Therefore, this project aims to solve this problem and establish an autonomous system for docking. The on-site autonomous docking should happen multiple times, allowing the team to explore large areas and perform long-term missions by deploying the individual robots according to the current task-specific requirements.

Tasks:

- Study of literature in an aerial-and-ground system of systems and identify most applicable methods for autonomous docking.
- Setup the simulation environment with an aerial-and-ground system.
- Implement the motion planning policy and evaluate the performance in a simulation environment under different conditions.
- Deployment on real hardware – aerial robot and legged robot ANYmal.

Literature:

[1] De Petris, Paolo, et al. "Marsupial walking-and-flying robotic deployment for collaborative exploration of unknown environments." 2022 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR). IEEE, 2022.

[2] Moore, Brandon, et al. "Combined Docking-and-Recharging for a Flexible Aerial/Legged Marsupial Autonomous System." 2023 IEEE Aerospace Conference. IEEE, 2023.

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[4] Arora, Prateek, et al. "Deep Learning–based Reassembling of an Aerial & Legged Marsupial Robotic System–of–Systems." 2023 International Conference on Unmanned Aircraft Systems (ICUAS). IEEE, 2023.

[5] Martinez Rocamora Jr, Bernardo, et al. "Oxpecker: A tethered uav for inspection of stone-mine pillars." Drones 7.2 (2023): 73.

[6] Mitchell, Colin, Graeme Best, and Geoffrey Hollinger. "Sequential stochastic multi-task assignment for multi-robot deployment planning." 2023 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2023.

Relevant Multimedia:

- Marsupial Walking-and-Flying Robotic Deployment for Collaborative Exploration

Relevant Funded Project:

- **Title:** ROI: RObotic Inspectors for semantic characterization of industrial facilities
- **Partners:** NTNU Adigo, Cognite
- **Funding Agency:** Research Council of Norway

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