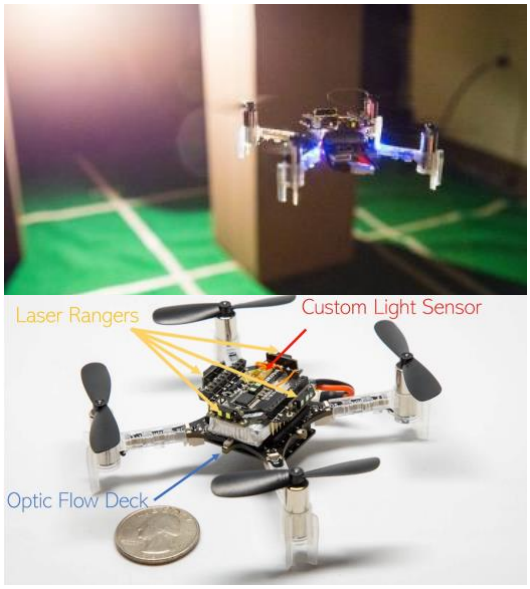
Navigation Policy for a Tiny Drone using Deep Reinforcement Learning

Abstract: Lightweight quadrotors are an ideal platform for fast exploration in confined environments thanks to their agility and small body's sizes. However, due to the limited payload that such tiny drones can carry, appropriate sensors and navigation software accounting for severely constrained resources onboard the robot need to be developed. Deep reinforcement learning offers a promising approach to design an efficient navigation policy by directly infer robot's action from noisy sensor observation. This project and thesis aim to address this challenge by equipping a tiny quadrotor with lightweight range sensing and using Deep Reinforcement Learning to find the near-optimal navigation policy for such robot in confined settings.



Tasks:

- Study and understand the basic Reinforcement Learning problem formulation, terminologies and common methods (Q-Learning, DDPG, PPO).
- Setup the simulation environment with simulated noisy range sensor feedback.
- Train the navigation policy and evaluate/improve the performance in simulation environment.
- Deployment on real hardware tiny quadrotor (Eigen, Tensorflow Lite).

Literature (indicative):

[1] B. P. Duisterhof et al., "Tiny Robot Learning (tinyRL) for Source Seeking on a Nano Quadcopter," 2021 IEEE International Conference on Robotics and Automation (ICRA), 2021, pp. 7242-7248, doi: 10.1109/ICRA48506.2021.9561590.

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[3] D. Dugas, J. Nieto, R. Siegwart and J. J. Chung, "NavRep: Unsupervised Representations for Reinforcement Learning of Robot Navigation in Dynamic Human Environments," 2021 IEEE International Conference on Robotics and Automation (ICRA), 2021, pp. 7829-7835, doi: 10.1109/ICRA48506.2021.9560951.

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[5] Mnih, Volodymyr, Kavukcuoglu, Koray, Silver, David, Graves, Alex, Antonoglou, Ioannis, Wierstra, Daan, and Riedmiller, Martin, "Playing atari with deep reinforcement learning," arXiv preprint arXiv:1312.5602, 2013.

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Relevant Funded Project:

- **Title:** SENTIENT: Science of resiliENt auTonomy In pErceptually-degraded eNvironmenTs
- **Partners:** NTNU, Scout Drone Inspection, DNV, Altera, Equinor
- **Funding Agency:** Research Council of Norway

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