# Wearable UAV (Research for new field development)

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## Abstract

For the mountain rescue and disaster relief, the rescue plan is built based on a limited source of information, which leads the less-effective operation and a risk of the secondary disaster. To solve this problem, personal flying system is developed, which carries a rescue team to the target area in advance to the main rescue operation. Gathering information and making decisions on-site contributes to the rescue plan with high reliability and effectiveness.

## Reasons and benefits of using JAXA Supercomputer System

The controller of the flying system is generated by deep reinforcement learning. JAXA supercomputer system is beneficial in that it enables the multi-core calculation for the deep reinforcement learning. In addition, it is effective to submit multiple jobs at a time for the paramter study.

## Achievements of the Year

Deep reinforcement learning was applied to generate controllers for the flight transition from level-flight to hovering.

The transition of the flight modes produces high nonlinearity in aerodynamics. To represent this dynamics, a theoretical model of aerodynamics was built, corresponding to the attitude angles' range over 360 degrees, which was used for training.

The reward function was designed to encourage controllers to stay at a target location, and did not explicitly define the hovering mode as a desired mode to stay at a fixed location. Nevertheless, the trained controller learned to smoothly transition from level-flight to hovering to reach and stay at the target (Fig. 1).

To examine the generalization capability of this training approach, the same controller was applied for other operations, namely target chasing (Fig. 2) and attitude recovering from spin (Fig. 3). In both operations, the controller demonstrated successful control.

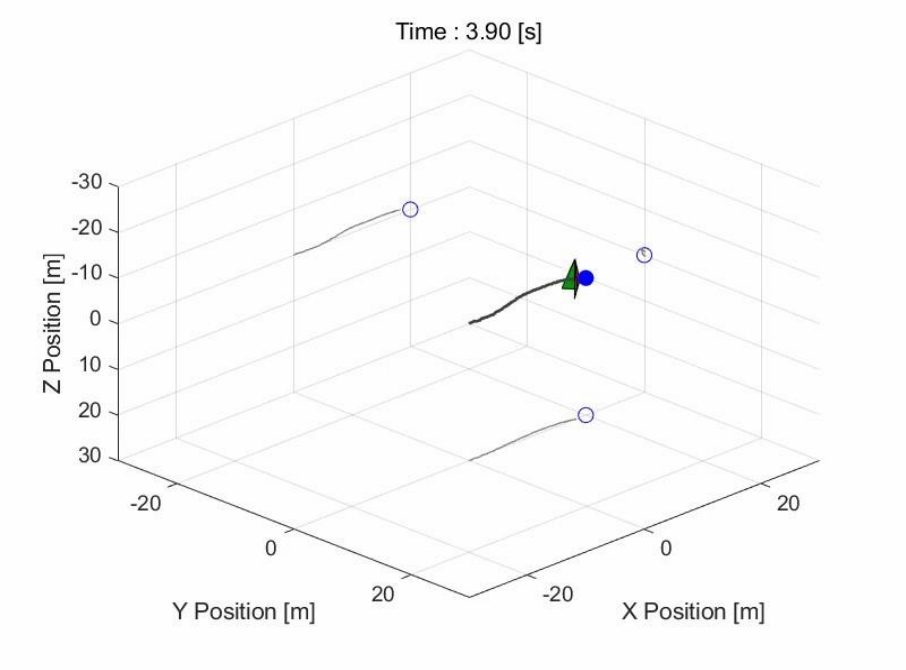


Fig. 1: Control result of the transition from level-flight to hovering. The aircraft smoothly transitioned towards the target location (blue). (Video. Video is available on the web.)

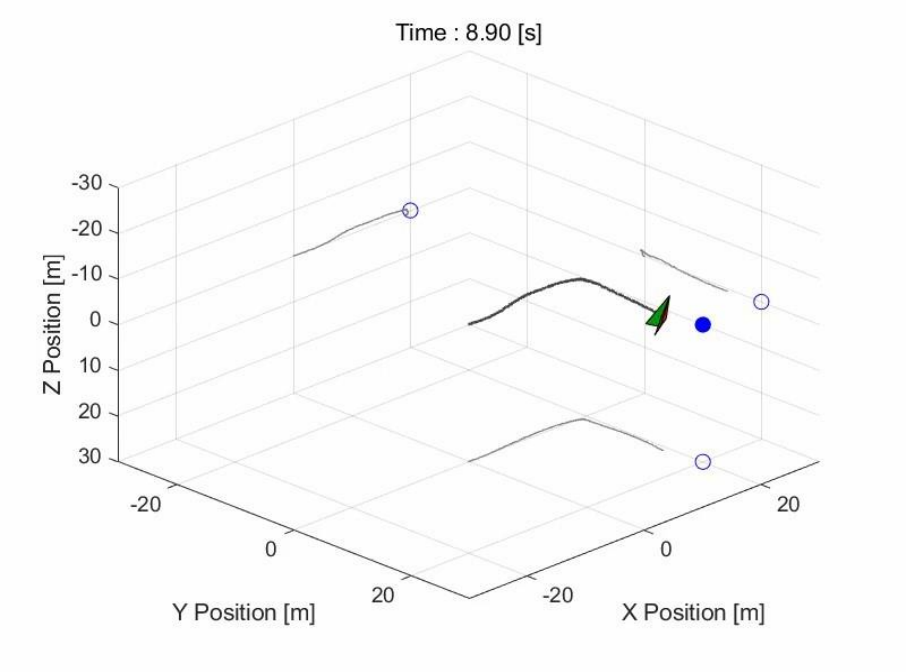


Fig. 2: Control result of the target tracking (target in blue). The aircraft successfully repeated the level-to-hover transition to chase the target. (Video. Video is available on the web.)

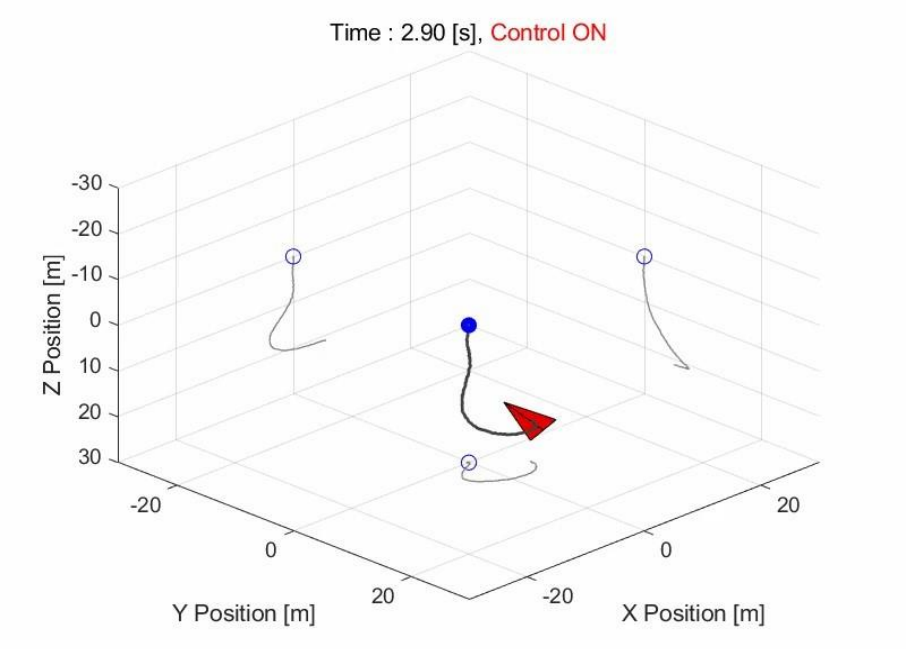


Fig. 3: Control result of recovering from spin. Initial angle rates were applied in simulation. Once the controller was activated, the aircraft successfully recovered the state and returned to the target location (blue). (Video. Video is available on the web.)

## Publications

N/A

## Usage of JSS

### Computational Information

| | |
|---|---|
| Process Parallelization Methods | OpenAI Gym and PyTorch. |
| Thread Parallelization Methods | OpenAI Gym and PyTorch. |
| Number of Processes | 1 - 36 |
| Elapsed Time per Case | 48 Hour(s) |

### JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.04

Details

| Computational Resources | | |
|---|---|---|
| System Name | CPU Resources Used (core x hours) | Fraction of Usage[*2](%) |
| TOKI-SORA | 0.00 | 0.00 |
| TOKI-ST | 19,444.81 | 0.02 |
| TOKI-GP | 54,510.30 | 36.22 |
| TOKI-XM | 0.00 | 0.00 |
| TOKI-LM | 1,728.02 | 0.13 |
| TOKI-TST | 0.00 | 0.00 |
| TOKI-TGP | 0.00 | 0.00 |
| TOKI-TLM | 0.00 | 0.00 |

| File System Resources | | |
|---|---|---|
| File System Name | Storage Assigned (GiB) | Fraction of Usage[*2](%) |
| /home | 5.00 | 0.00 |
| /data and /data2 | 50.00 | 0.00 |
| /ssd | 50.00 | 0.01 |

| Archiver Resources | | |
|---|---|---|
| Archiver Name | Storage Used (TiB) | Fraction of Usage*2(%) |
| J-SPACE | 0.00 | 0.00 |

*1: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.

- **ISV Software Licenses Used**

| ISV Software Licenses Resources | | |
|---|---|---|
| | ISV Software Licenses Used (Hours) | Fraction of Usage*2(%) |
| ISV Software Licenses (Total) | 0.00 | 0.00 |

*2: Fraction of Usage：Percentage of usage relative to each resource used in one year.