The Open-Source Development of UTokyo Aerial Robot Team: From Hardware to Software

Scan here!

GitHub Repo: https://github.com/jsk-ros-pkg/jsk_aerial_robot
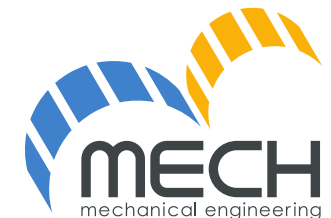
Jinjie LI

Doctoral Student
Department of Mechanical Engineering
The University of Tokyo

Table of Contents

Introduction

UTokyo Aerial Robot Team

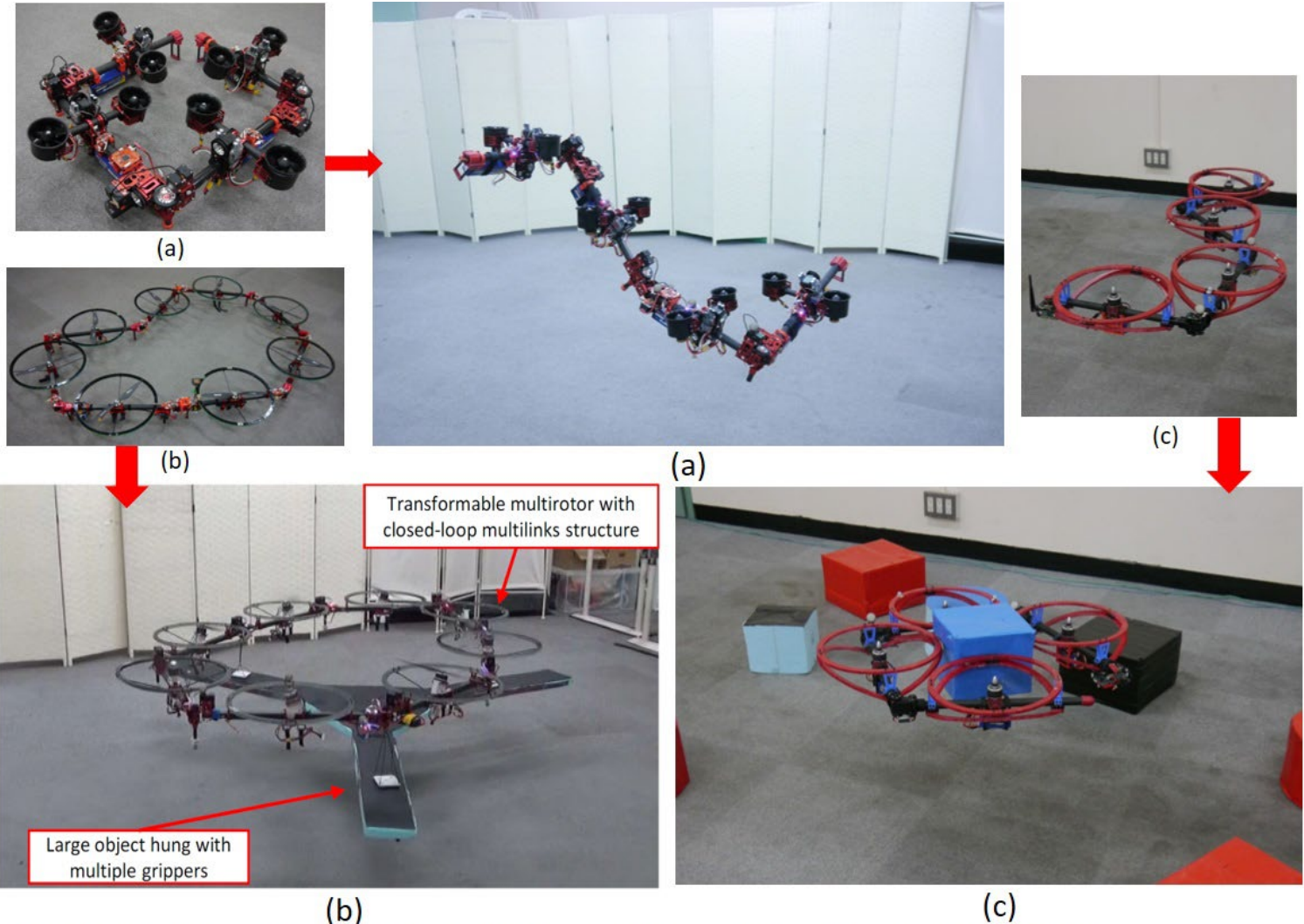## Main Research Field: Aerial Robotics

Lecturer Moju Zhao (赵 漠居)

Department of Mechanical Engineering

- D1, Jinjie LI
- M2, Haruki Kozuka
- M1, Junichiro Sugihara
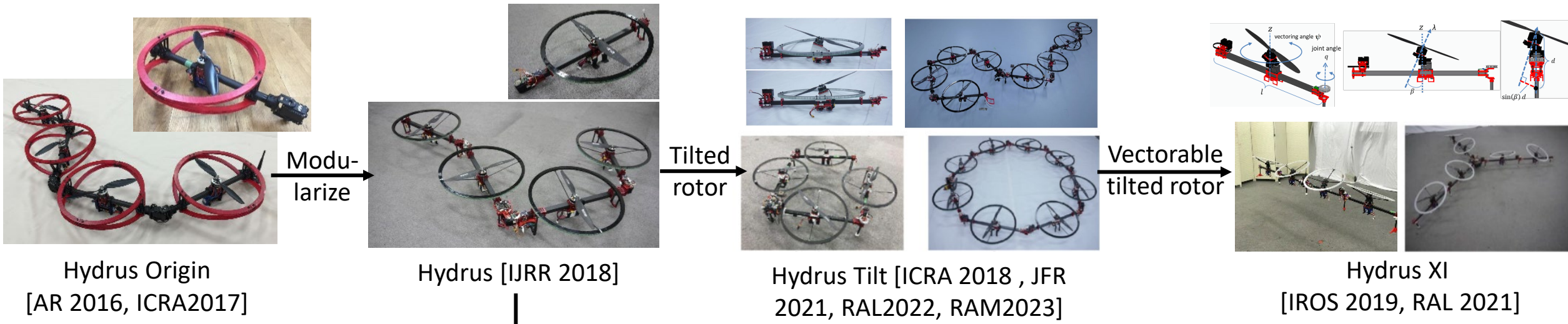- M1, Kazuki Sugihara
- M1, Yunong LI

Our team is growing …

Transformable multirotor with closed-loop multilinks structure

Large object hung with multiple grippers

Transformable aerial robots. (a): 3D aerial transformation by **DRAGON**; (b): picking large object by **HALO**; (c): whole body aerial manipulation by **HYDRUS**.
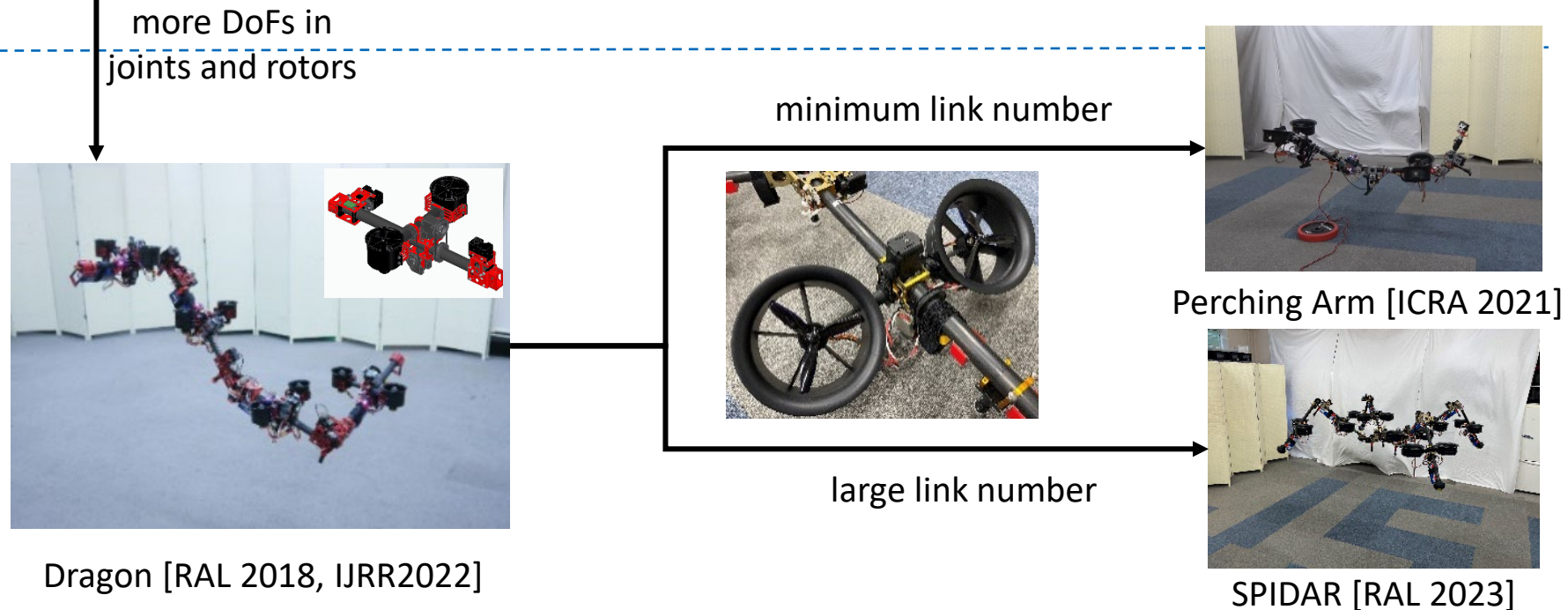
Development of Articulated Aerial Robots

Hydrus Origin
[AR 2016, ICRA2017]

Modularize →

Hydrus [IJRR 2018]

Tilted rotor →

Hydrus Tilt [ICRA 2018, JFR 2021, RAL2022, RAM2023]

Vectorable tilted rotor →

Hydrus XI [IROS 2019, RAL 2021]

Two-dimensional model
- -
Three-dimensional model

more DoFs in joints and rotors

Controllers
- PID,
- LQI,
- Adaptive Control
- Nonlinear MPC
  ...

minimum link number

Perching Arm [ICRA 2021]

Dragon [RAL 2018, IJRR2022]

large link number

SPIDAR [RAL 2023]

System Architecture

Our control algorithms are highly related to our robots.
Challenge: How to make the whole system reproducible?
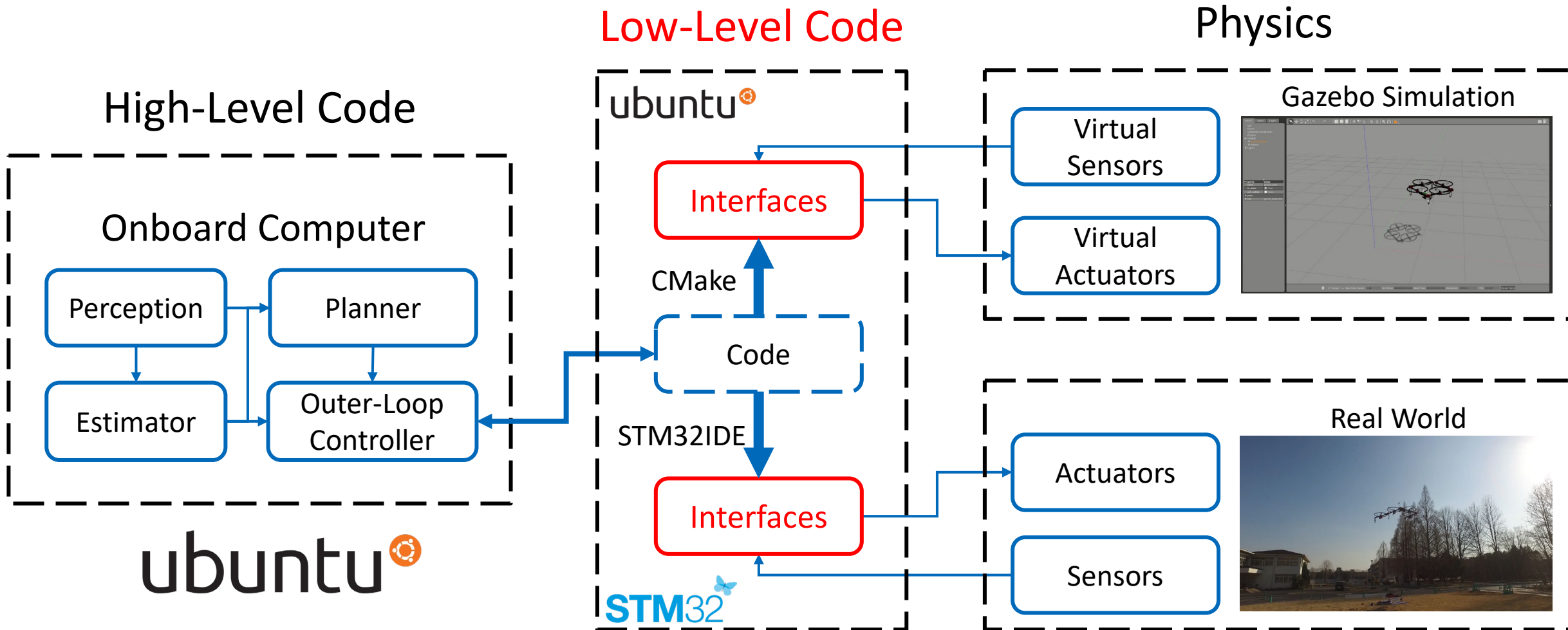
Get Started with Our Robots

Setup

Repository: https://github.com/jsk-ros-pkg/jsk_aerial_robot

```
source /opt/ros/${ROS_DISTRO}/setup.bash # please replace ${ROS_DISTRO} with your specific env varia
mkdir -p ~/ros/jsk_aerial_robot_ws/src
cd ~/ros/jsk_aerial_robot_ws
sudo rosdep init
rosdep update
wstool init src
wstool set -u -t src jsk_aerial_robot http://github.com/jsk-ros-pkg/jsk_aerial_robot --git
wstool merge -t src src/jsk_aerial_robot/aerial_robot_${ROS_DISTRO}.rosinstall
wstool update -t src
rosdep install -y -r --from-paths src --ignore-src --rosdistro $ROS_DISTRO
catkin build
```
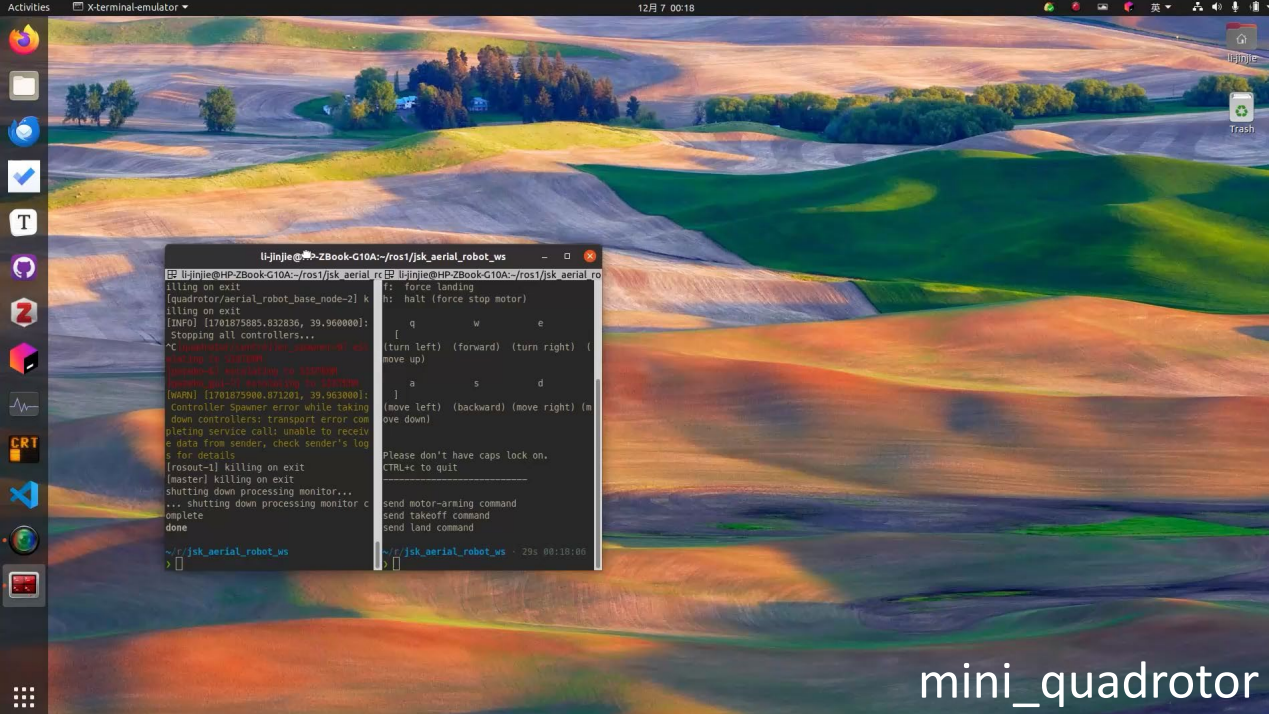
GitHub

Scan here!

hydrus, mini_quadrotor

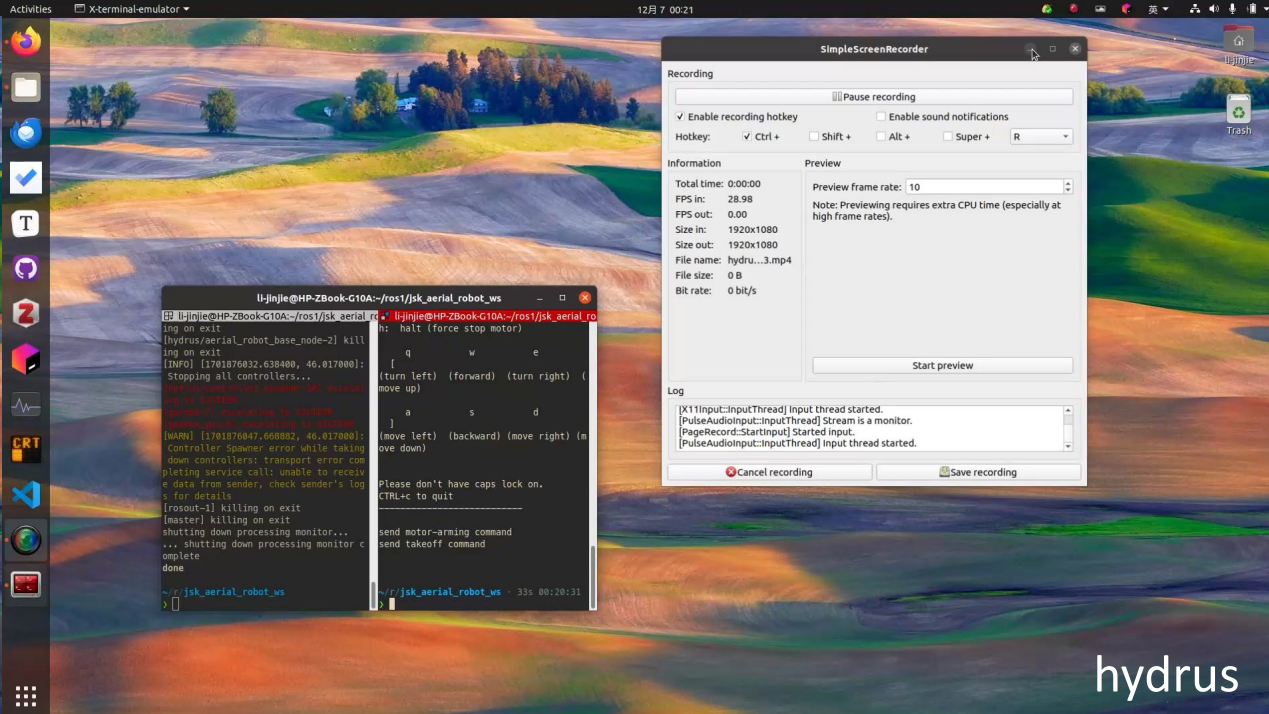$ roslaunch dragon bringup.launch real_machine:=false simulation:=true headless:=false

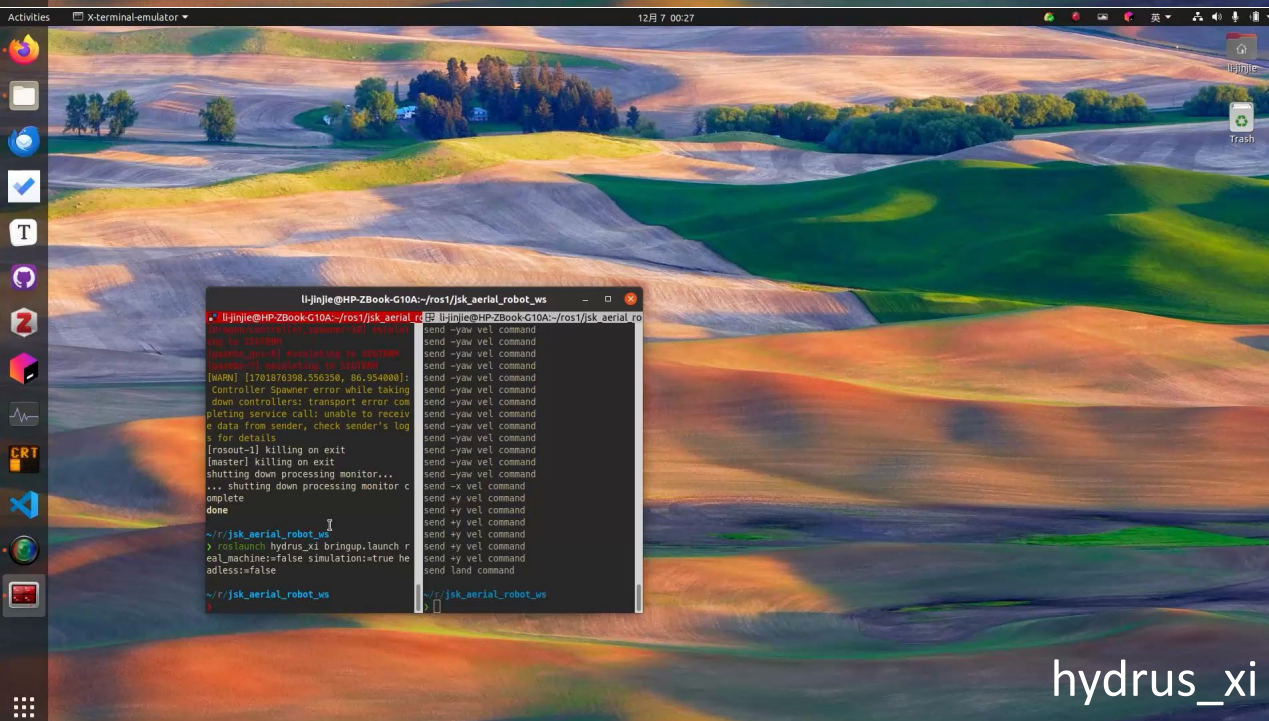$ rosrun aerial_robot_base keyboard_command.py   One interface for all robots!
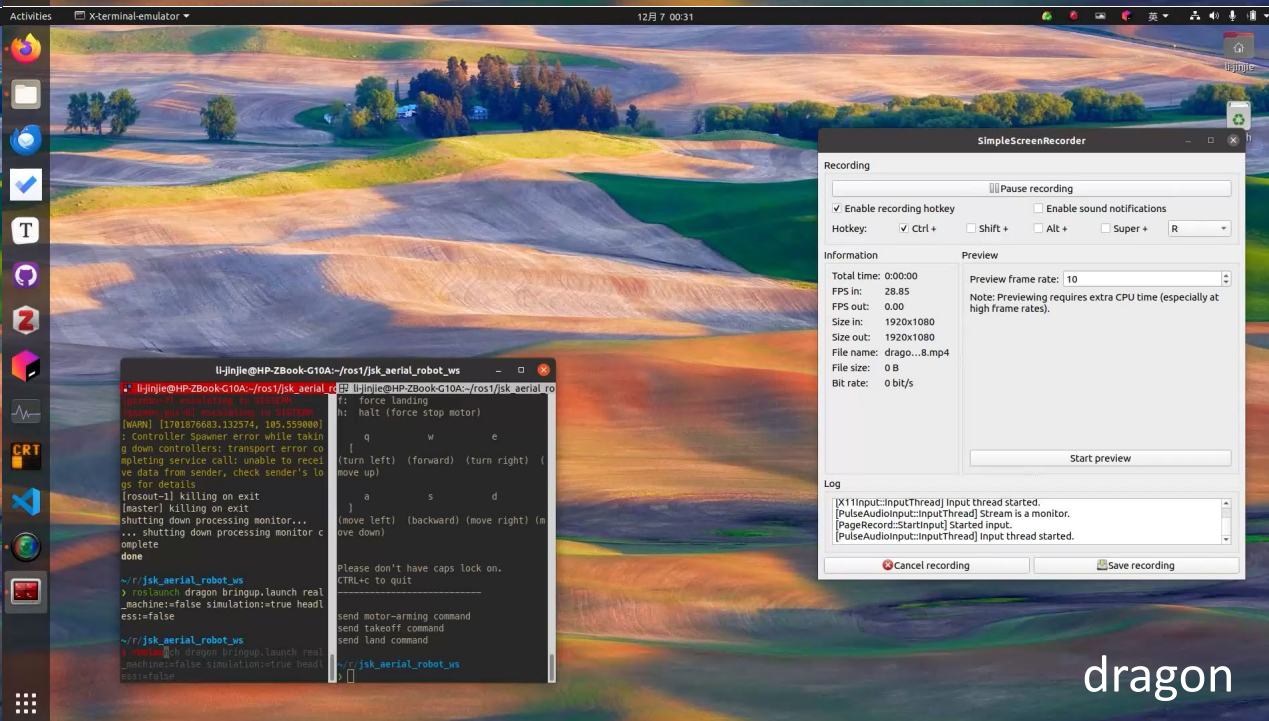
Wiki: https://github.com/jsk-ros-pkg/jsk_aerial_robot/wiki

mini_quadrotor

hydrus

hydrus_xi

dragon

Continuous Integration (CI)

After each PR (Pull Request) and each commit to the main repository......

Purpose

For developers:
- Compatible with previous code
- Fast implementation from sim to real

For users:
- Easy to install and try
- Compatible with different ROS env

Virtual User
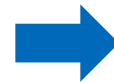- ROS Kinetic
- ROS Melodic
- ROS Noetic

Future Work

- A general platform for multiple domains (air, ground, water)
- A platform to test the generality of control algorithms
- Open to light users

Future Tasks

- Migrate to ROS2
- More documentations
- More developer-friendly interface

Thanks for listening

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https://github.com/jsk-ros-pkg/jsk_aerial_robot

Scan here and
try our robots!