Simulating Modeling and Control of Crazyflie

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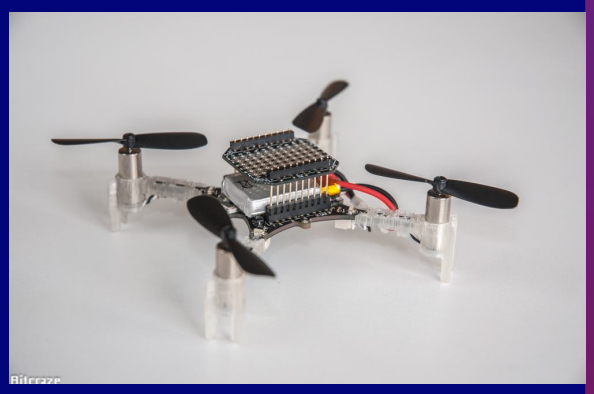
Introduction:

The Crazyflie is a compact, open-source quadcopter weighing just 27 grams. Developed by Bitcraze AB, it features an ARM Cortex-M4 flight controller, inertial sensors, and wireless connectivity. Its palm-sized design and affordable cost make it popular for educational and research purposes in unmanned aerial vehicle technologies. The open-source nature allows customization of hardware, firmware, and software, fostering experimentation and innovation among academic and hobbyist communities.

Methodology:

1. The idea is to write python scripts that control the flight of the Crazyflie module.
2. But before they can be used, they require rigorous testing in a safe, risk free environment.
3. For this purpose, we used ROS Noetic (Robot Operating System), to simulate and test our scripts.



4. Along with ROS Noetic, we use Gazebo as a graphical virtual environment for our tasks.
5. The testing was all done on a KDE Plasma environment, Ubuntu 20.04 machine, which, while no longer supported actively, still performs as is to be expected.
6. Every module was built through *catkin,* the official build system of ROS 1.0.

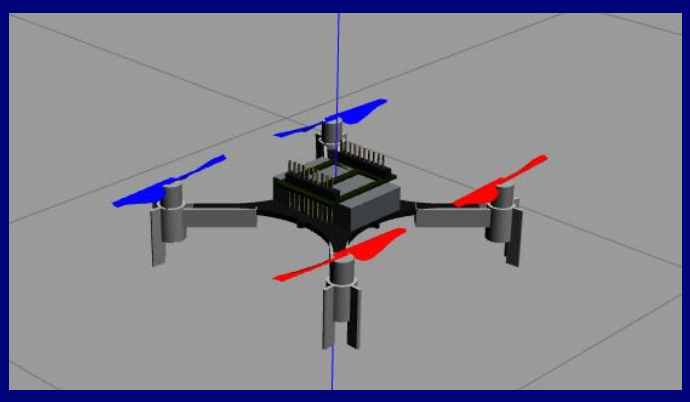
Conclusion:

We were able to successfully use ROS and Gazebo to model, simulate, and control the dynamics of the Crazyflie quadcopter. By developing Python scripts integrated with ROS, we were able to accurately capture the behavior of a single Crazyflie and extend it to simulate swarm behavior with multiple Crazyflies.

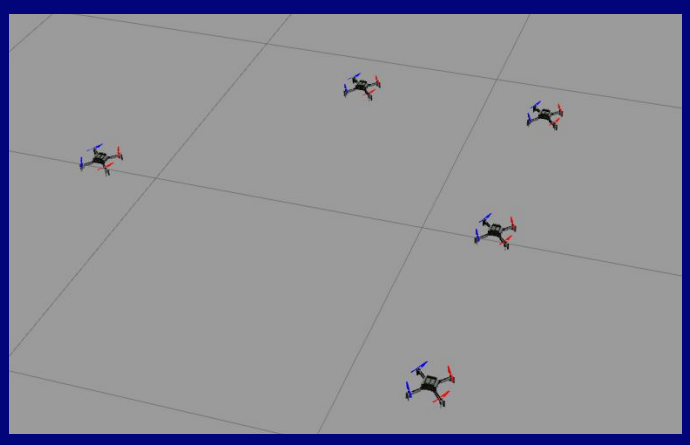
This gives us an upper hand when trying to script trajectory, or in the future, automate flight of a copter. By simulation and testing, the success rate of real world flight increases by a considerable margin, resulting in more reliable firmware development.

Results:

1. The first test was basic, automated hovering for a single module:



2. The second test was simulating flight of multiple modules, hence, a swarm:



References:

1. CrazyChoir: Flying Swarms of Crazyflie Quadrotors in ROS 2, Pichierri, Lorenzo and Testa, Andrea and Notarstefano, Giuseppe, IEEE Robotics and Automation Letters, 8, 2023
2. https://github.com/OPT4SMART/crazychoir
3. http://wiki.ros.org/noetic/Installation/Ubuntu