ÉCOLE POLYTECHNIQUE
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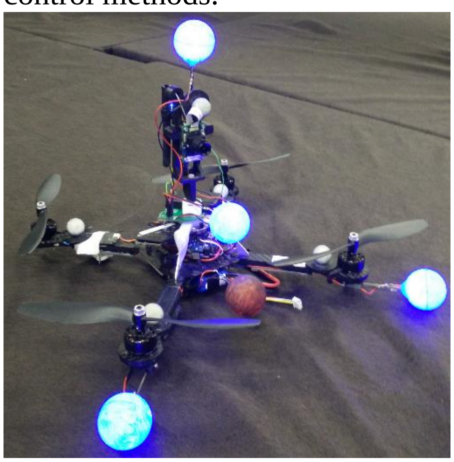
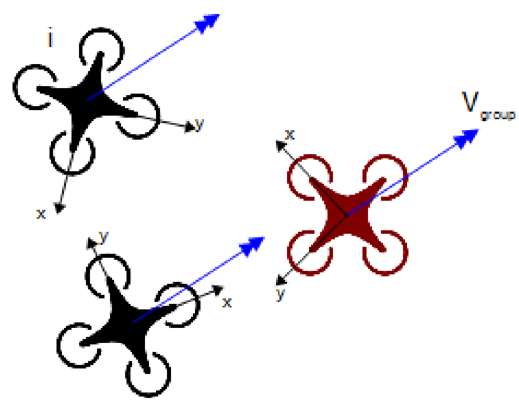
This project focused on implementing and simulating guidance algorithms which would allow a formation of quadrotors to move through its environment using only local measurements, while avoiding inter-vehicle communication. The motivation for this approach was that relative measurements continue to work in indoor environments, and inter-vehicle communication is subject to issues such as lag which affect each vehicle in the formation differently, potentially leading to instability in the formation. The final part of the work involved testing the quadrotor formation control software using the real hardware, so as to be able to test the formation guidance algorithms.

The guidance algorithm development was performed in a framework previously developed in ROS by Steven Roelofsen and Duarte Dias, based on consensus formation control algorithms previously implemented by Sven Gowal. The first step in the project was to become acquainted with ROS and the theoretical foundations of the formation control methods.





Two different guidance algorithms were proposed, and one, which controlled the velocity of the quadrotor formation, was selected to be investigated more thoroughly. This guidance algorithm allowed the formation to follow a trajectory defined by a sequence of velocity commands. Simulations were performed to determine how the formation and guidance would behave when different vehicles in the formation were subjected to communication problems. These included packet loss, lag and noise being applied to the velocity commands. These simulations were performed in Webots, using formations of two to four quadrotors.

The formation and guidance software was loaded onto three Asctec Hummingbird quadrotors, and a sequence of tests was undertaken to determine how well the relative-measurement control functioned on real hardware. Various real world effects were addressed, including camera calibration issues, embedded processor speed limitations and camera position and distance estimation errors.