Design and Development of a SysML Based Model and HIL Simulation of Collaborative Autonomous UAV Mission with Fixed Geometrical Formation

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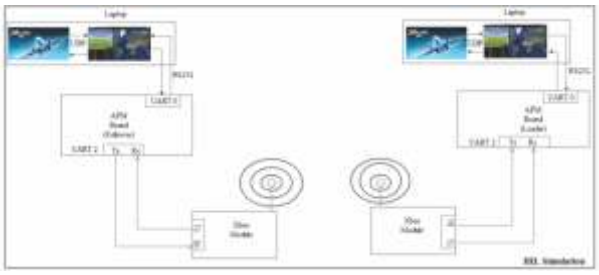
Abstract:

Unmanned Aerial Vehicles (UAVs) are autonomous flying vehicles equipped with sensing devices and possibly weapons. A single UAV tends to be complex, expensive and completion of task is often time consuming. Therefore it is advantageous to use Multiple UAVs for a task, such as surveillance rather than a single UAV. A collaborative team of autonomous UAVs can provide more effective operational capabilities to accomplish hard and complex task. But, the critical problem in realizing such multivehicle systems is to develop an efficient coordination and control algorithms to manoeuvre each vehicle, so that the Multi-UAVs as a whole can produce flexible group behavior.

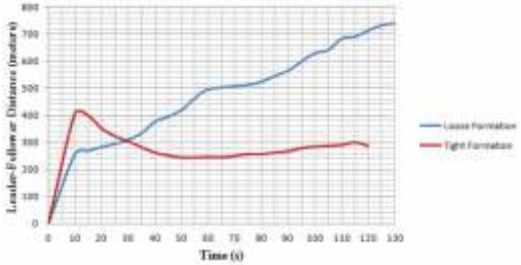
This project deals with the design and development of a SysML based model and HIL Simulation Model for UAVs performing collaborative missions with fixed geometrical formation. To fulfill the collaborative mission, appropriate algorithms are identified and innovated which helped the Multiple UAVs to produce a flexible group. The collaborative mission is accomplished using two UAVs (Leader and Follower) at a time. The Leader UAV will fly on a predefined flight path and the Follower UAV tries to maintain a fixed geometrical formation with respect to the Leader flight path. The coordination between Leader and Follower UAVs is maintained through a bidirectional wireless communication. Development of HIL Simulation Model for UAVs performing collaborative missions follows the V-model process.

Appropriate test strategy and phases are identified, to test the developed model. The behavior of Leader-Follower UAVs is observed in mission planner at different positions of flight path. During the verification process for tight formation algorithm the Follower UAV was unable to maintain the same altitude as the Leader UAV, while tuning with only throttle. This was corrected by tuning both throttle and pitch. As a part of future work, features like formation flying on more than two UAVs, simulating multiple UAVs in one PC and collaborative flying using two different unmanned vehicles can be incorporated.



HIL simulation

HIL model for collaborative mission



Performance of algorithm