Fly Sense

Team C – ILR06

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Work done these past 2 weeks

Over the past two weeks we have

a) Been able to fly the quad copter with and without weights
b) Worked on the onboard power
c) Initiated the setup of the TK2 (upgrade from TX1)
d) Initiated the work to deploy an onboard camera
e) Detailed how the code will work for the sound and coloring algorithms

Nick has been working mostly with the quadcopter hardware to make all the needed changes to fly with and without weights, have power available on board.

Hari has been focused on doing the TK2 and Velodyne setup.

Nihar has been focusing on deploying the onboard camera deployment/video merging (birds eye view overlaid with FPV video coming from the quadcopter to mimic the conditions of being onboard the quad in line with the use case of FlySense deployed in a quadcopter).

I have mostly been working mostly with Shivang on detailing how to implement and test the coloring and sound algorithms. The upgrades being done are:

a) Upgrading algorithm from 2D to 3D (from a cart to a flying quadcopter)
b) Upgrading algorithm from a point to a rigid body
c) Taking into account the quad dynamics rather than projecting forward at current speed
d) Coloring based on maximum potential input from the pilot
e) Generating sound warnings based on the current input from the pilot

Individual achievements for the past 2 weeks

<u>Coloring and sound warnings implementation</u>

The code will be developed and tested in Matlab and converted to C++ for deployment in our hardware. The development tests will be done with handmade dummy data, followed by testing with offline data produced from a flight.

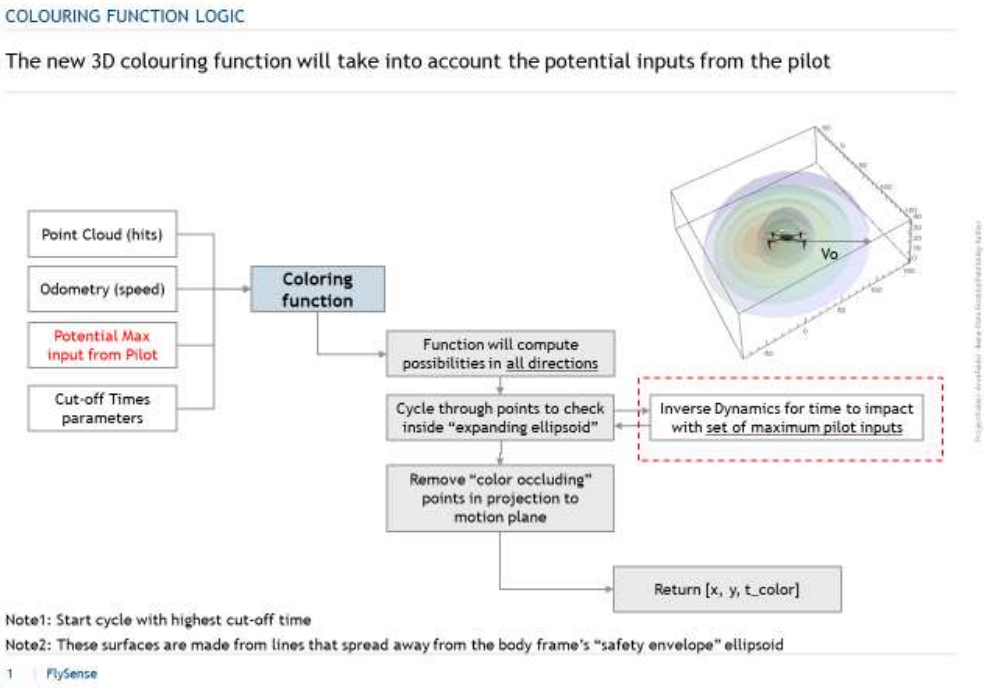
After getting both the sound and coloring codes working separately, we will try to integrate them together to ensure that we only cycle once through the different points. From this point onwards, we will use points and obstacles as synonyms (given that in practical terms the output coming from the LIDAR is a point cloud where each point will be treated as an isolated obstacle).

<u>Coloring Algorithm</u>

The coloring algorithm code will work as follows:

- The collision surface will be an ellipsoid that will expand across time based on the maximum quad dynamics (initial conditions and maximum pilot input in any direction)
- Color occlusion will be minimized by removing “irrelevant points” (e.g. green points that are projected in XY “too close” to the red ones for the human eye to distinguish)

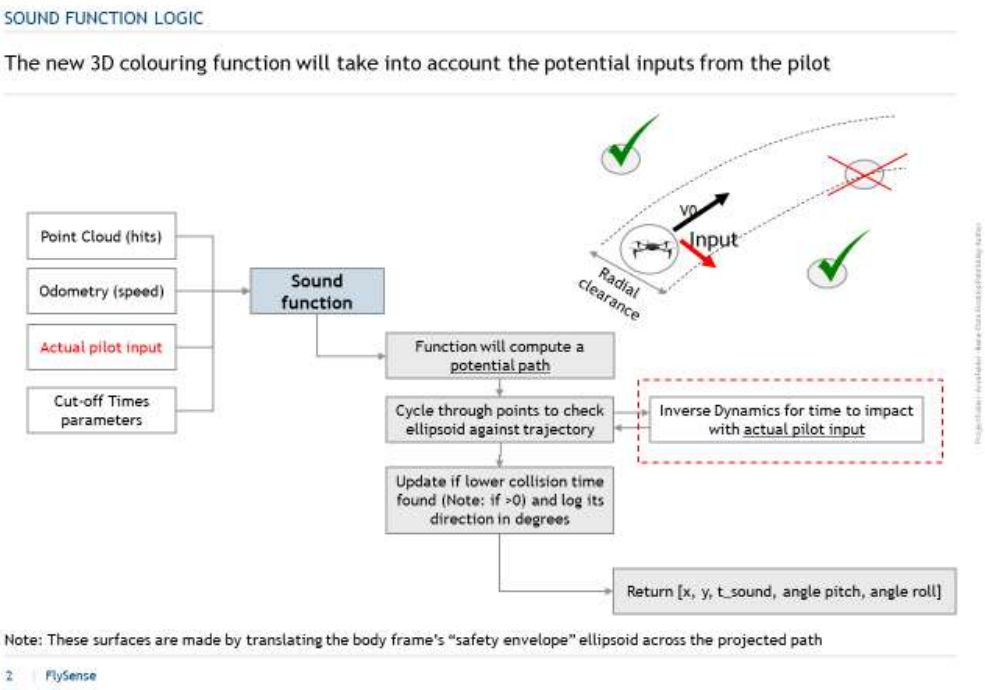
- Frame of reference for function inputs will have
    - All speeds and coordinate inputs will be in the body frame of the quadcopter
    - X axis pointing forward in the quadcopter and aligned with Velodyne reference axis



Sound Algorithm

The sound algorithm code will work as follows:

- The collision surface will be the body frame ellipsoid translated without any deformation across the projected trajectory (initial conditions and current pilot input)
- The output from this function will be only the most "dangerous" obstacle, corresponding to the point that has the shortest positive collision time based on current pilot input
- The function will also output the roll and pitch angles of the most dangerous obstacle so that we can try to better segment its sound warning to the pilot (e.g. forward and backwards and not only left and right)
- The reference for measuring the pitch and roll of the most dangerous obstacle will be the x axis of the quadcopter (and not its speed vector as in the first semester)
- The output forms this function will be reused as an input in for the obstacle avoidance function that will be written in a few weeks
- Frame of reference for function inputs will have
    - All speeds and coordinate inputs will be in the body frame of the quadcopter
    - X axis pointing forward in the quadcopter and aligned with Velodyne reference axis



Problems Faced these past weeks

The biggest problem is, as always, a substantial load from all the different courses… made worst by the fact that this semester there is not only one group to interact with across three different courses, but rather a different group for each course.

Nihar also had an accident with his laptop where he accidently poured a liquid on top of it…. We found that his laptop is kind of allergic to that and he had to replace its memory.

Milestones for next two weeks:

For the next PR I plan to have:

a) Coloring code for the Bird's Eye view ready and tested
b) Sound warning code for alerting near collisions ready and tested
c) Work initiated on the collision avoidance algorithm

Key risks:

We have a lot of work in the coming days on the ramp up to the SVE, with risks concentrated on:

a) Nailing down the dynamics of the quadcopter against pilot inputs
b) Navigating through the heavy load coming from multiple assignments across all courses