Fly Sense

Team C – ILR06

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Work done these past 2 weeks

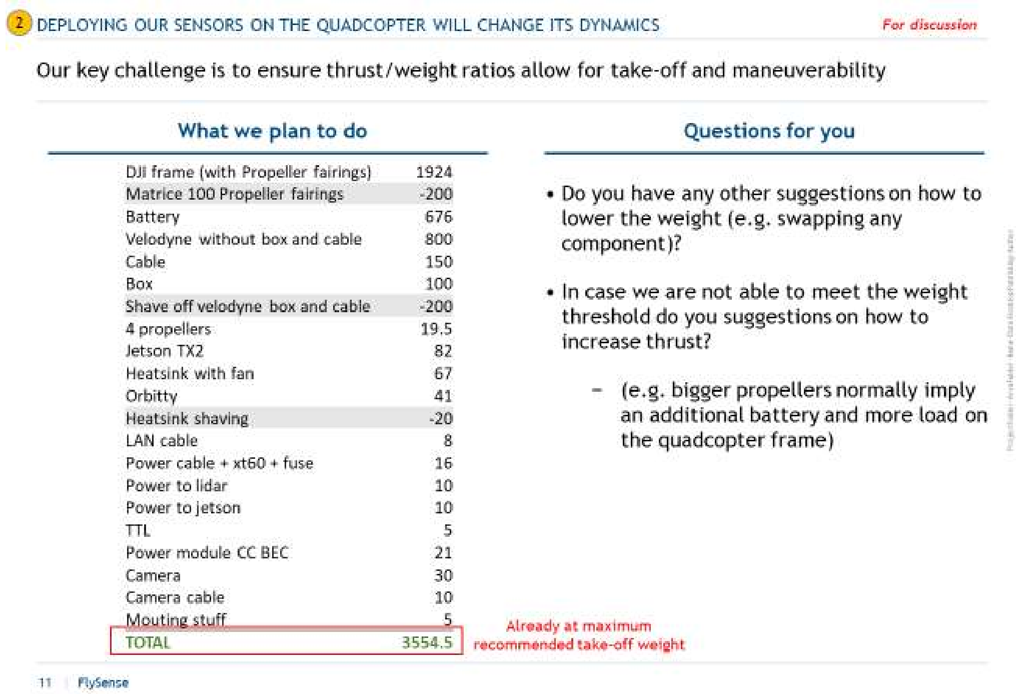
Over the last few weeks we have been reengaging with the work, focusing mostly on:

a) Getting the quad flying (without our solution)
b) Designing the algorithms we want to implement

Below a quick overview:

Quad Flying

- Several flights have now been performed without our solution onboard (no payload), and we are trying to reduce the weight of the quadcopter so that we can fly our payload on it without substantial degradation of performance



UI/UX

- Work has focused mostly on understanding how to design an algorithm that can work in an environment that is substantially noisy.

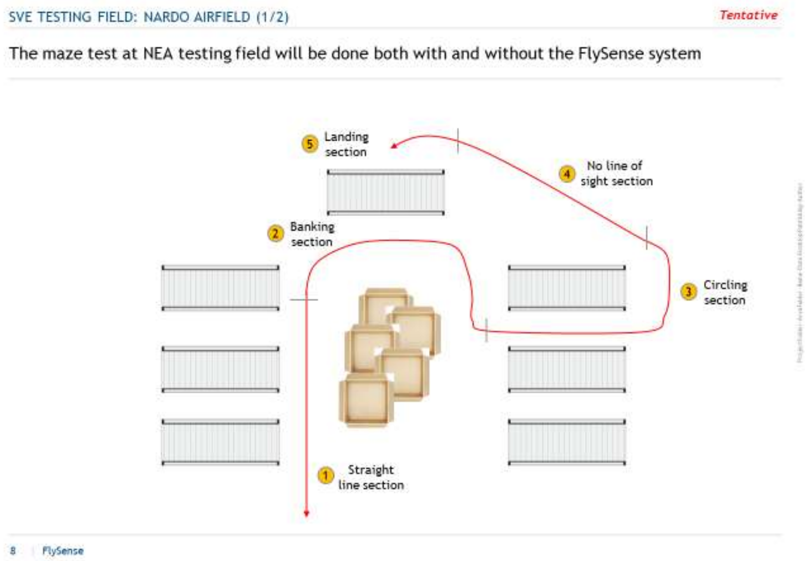
- We are also designing the final interface for the SVE, that will be used by NEA pilot to navigate through the maze of their testing sensor using our solution. Below one of the mock-ups currently being discussed within the team:

Quadcopter dynamics

- Substantial effort has been done in analyzing the theoretical behavior of the quadcopter, so that we calibrate our models with real data as soon as possible.

Designing the SVE test

- Field visit to NEA test facilities has been performed in order to analyze the best way to structure SVE (that we had the opportunity to discuss with the entire class during "Design Review"



Problems Faced these past weeks

The biggest problem is, as always, a substantial load from all the courses (reminds me of when I was a business consultant …😉!)

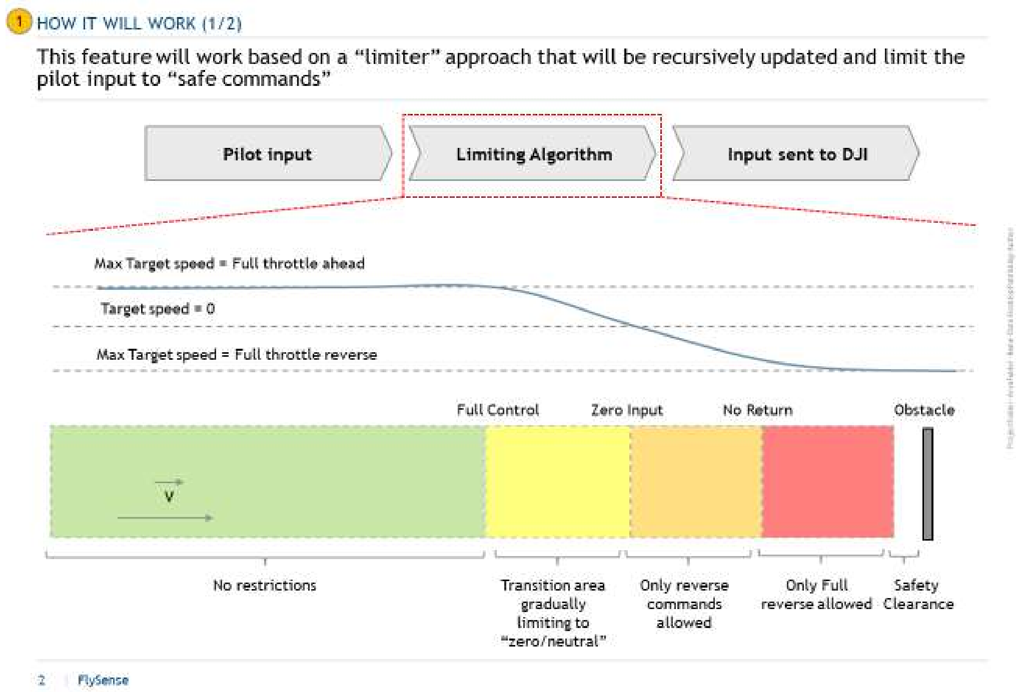
… but we will manage somehow!

Individual achievements for the past 2 weeks

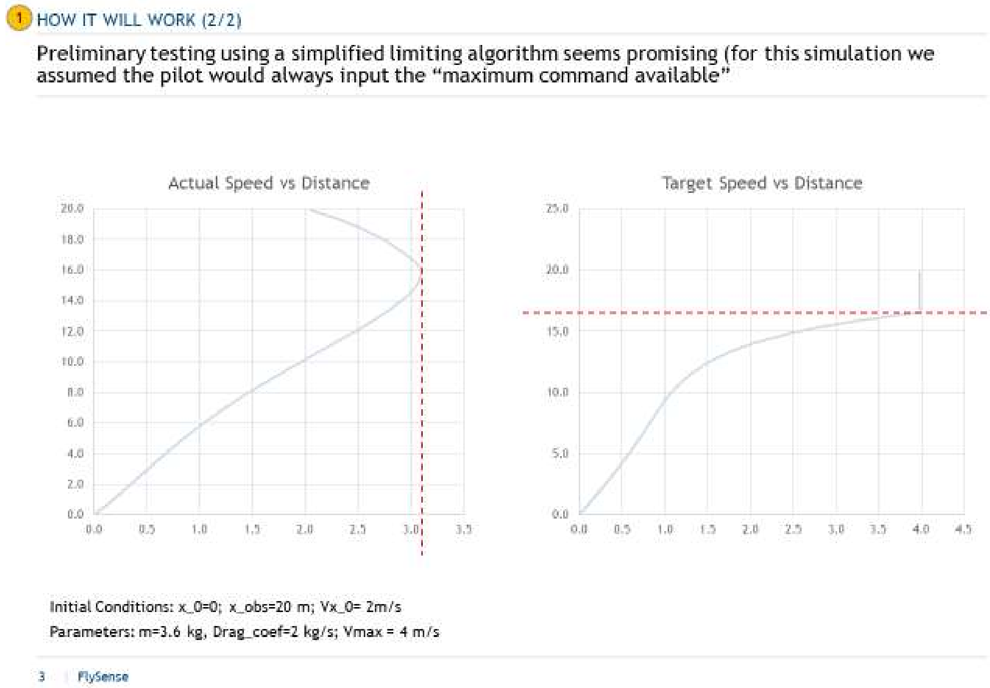
Over the past two weeks I have:

a) Designed the high-level concept of the obstacle avoidance feature:

- Using a flat infinite virtual wall as an obstacle (rather than real obstacles)
- Reusing as much as possible from DJI's interface as possible (to prevent stability, navigation or control problems)
- Defining the control as a "limiter", only blocking pilot access to the set of commands that will "crash" into the obstacle



b) Understood in detail how the differential equations of a quadcopter work, having performed several dummy simulations (namely how the algorithm would behave when a pilot by default always introduced the "maximum possible" input



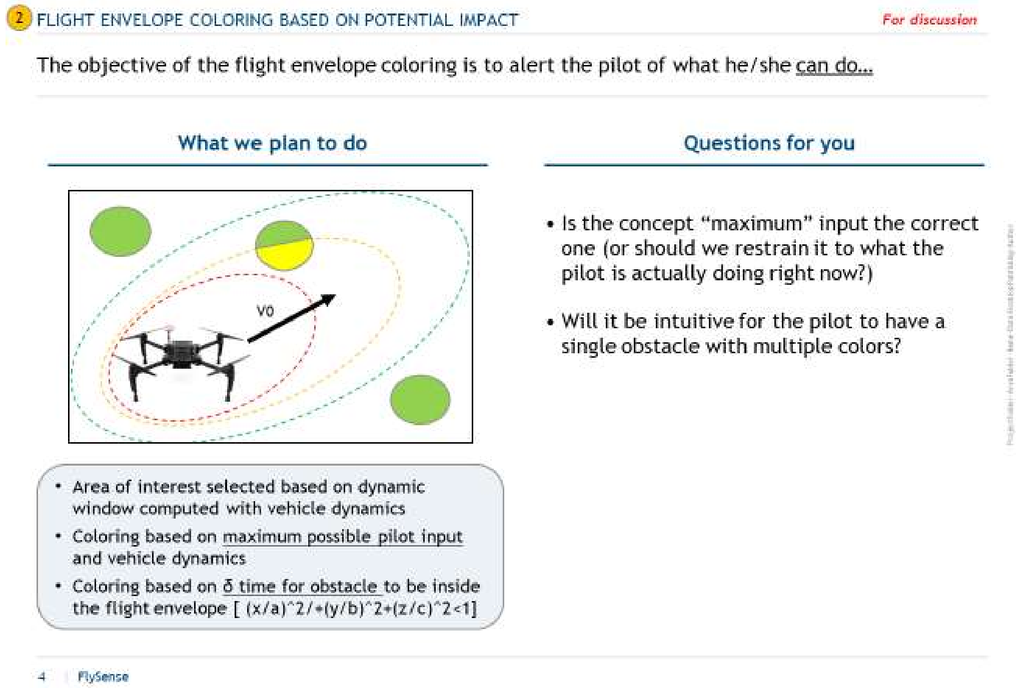
Note: In the slide above, on the left, the actual speed is show against the distance to the wall. On the right the target speed selected by the pilot in the control is equally shown against the distance to the wall.

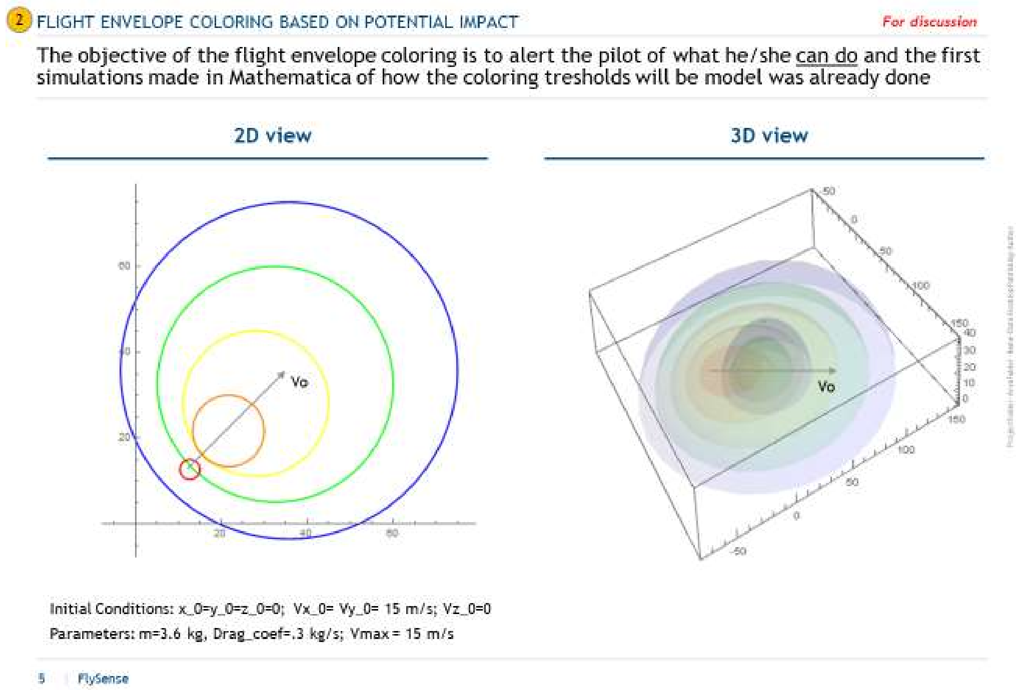
Note2: To ensure smoothness, and correct speed of convergence, the algorithm used was based on a logarithm control based both on speeds and distances to the wall under the "maximum input allowed".

In the next few weeks, working with Shivang, I plan to log real flight data (including pilot inputs) in order to understand how DJI electronics is handling the pilot inputs and how best to implement this feature.

The dynamics of the quadcopter will be used not only on the crash avoidance, but also on the Bird Eye's view coloring of obstacles and the sound warnings generation. Both of them described in the next sections.

c) Designed the concept of the coloring algorithm for the obstacles presented in the Bird's Eyes view, and did a simplified simulation in Mathematica to illustrate the concept so that it could be discussed within our group.





d) Analyzed the implications of upgrading the sound warnings to a 3D environment where pilot inputs are taken into account to predict the quad trajectory. Preliminary simulations indicate that the Newton Method seems to be the best option available to detect the time of interception with the different obstacles. This is due to the fact that the dynamics of the quad is described by exponentials approaching a steady state speed, and thus are monotonic by nature.

Milestones for next two weeks:

I will be working mostly with Shivang, focused on understanding the actual dynamics of our quadcopter with our payload. This is the key achievement needed to initiate work in:

a) Final algorithm of collision avoidance
b) Final coloring code for the Bird's Eye view
c) Final sound warning code for alerting near collisions

With the entire team: Discuss the Spring Validation Experiment (the clock is ticking!!!)

Key risks:

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

a) Getting the quad up and running with our payload
b) Nailing down the dynamics of the quadcopter against pilot inputs