One of the major features that was implemented this sprint was the conflict calculator. This is the system that will be employed on the plugin’s backend to compute the probability of conflict and collisions. This user story involved performing the feature level design and algorithm analysis. The only deviation from a standard feature level design is that I experimented this time with doing this in Mathematica instead of PowerPoint and integrating it directly into the visual studio solution so other developers can have access to the algorithm analysis right next to where the code implementation of this feature exists.

Once the system and algorithms were designed, the next step was to provide a software implementation of these features within our plugin solution. To illustrate what the conflict calculator is and set the stage for the demo, I’ve got a few slides.

GO TO SLIDES

SLIDE 2

So as we said, the conflict calculator is an algorithm to predict the probability of airspace breaches. At the basic level, the inputs to this system are both the 3D position of the aircraft and some statistical information about the confidence of these locations. The system will then analyze this scenario and provide a worst case estimate of conflict probability.

Some of the goals of this system are to be able to provide mathematically conservative guarantees of the analysis.

We would also like to allow the user to define a desired confidence level so they can tune the system. In other words, if the system is being too conservative, the user can turn a dial to reduce the amount of false positives at the cost of conflict guarantees.

Finally, we wanted closed form, analytical solutions for conflict probabilities instead of monte carlo style iterative numerical calculations.

SLIDE 3

So for example, if we have these two aircraft, we need to account for the fact that their positions may not be exactly known and therefore we need to model their position’s using stochastic variables.

To do this, we model the aircraft’s altitude as a 1D Gaussian probability distribution function.

We then model the aircraft’s planar positions as a 2D Gaussian PDF.

So in other words, we assume that aircraft A may have a PDF like this

Whereas aircraft B may have a PDF like this,

When we are performing calculations with these distributions, we then conservatively over-bound calculations when necessary to obtained closed form, worse case calculations.

So for example we conservative allocate this airspace to aircraft A.

SLIDE 4

The reason why this is useful is we can now use this system to analyze potential aircraft of aircraft when they are engaged in free flight, orbits, or path following.

We can create a map which conveys areas of potential risk of conflicts and visually display this to the operator.

We can provide a mathematically sound tool to perform temporal predictions in the face of stochastic system variables.

And we can handle degraded GPS or position information gracefully.

So for example, we could have these two aircraft, the user could select the scan eagle and ask for a conflict analysis, and the system could highlight areas of potential conflict to them.