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HW3 Report
2/5/19

My Collision Avoidance Strategy & Simulation:

My collision avoidance strategy has a central controller detect when UAVs are within 6 meters of each other, then instructs one to rise and one to fall 5 meters while continuing to their waypoint objectives. It performed pretty well! I would be interested to see how the performance would be if the groundspeed was increased because then they might not have enough time to react. If I'd have had more time, I would have liked to see if it was feasible to send the other UAVs to each other's threads so they can detect for themselves when collisions are likely. Also, with more time I would have cleaned up logging and running all 10 test simulations at once. I had originally designed my code to run as a single simulation per the instructions in section 3, then in section 5 it said to make all 10 simulations run in one execution and I had to throw those encompassing loops and control features together rather quickly. ☹

Collision Avoidance Summaries:

Automobile Collision Avoidance systems are designed beginning with the framework that in the event of even an unavoidable collision, minor corrections can still be made to prevent serious harm or damage to property. Therefore, many automotive CA systems utilize the forward-facing sensors that adaptive cruise control uses. From these sensors, the car can determine if the speed differential between itself and an object ahead of it poses danger of a rear-end collision. In this case, some systems alert the driver, others pre-charge brakes to prepare for the abrupt stop the driver is about to initiate, and a few even bring the car to a stop.

The TCAS II system constantly emits and receives radio signals which allow on-board simulators to build a 3D map of the surrounding airspace while also alerting other aircraft to their own location in the airspace. Each system is self-contained, meaning there is no central coordination device. However, the TCAS II system will negotiate between similarly equipped aircraft when a collision is predicted to negotiate one plane gaining altitude and the other descending.

The ClearPath person collision avoidance system has each agent compute a space of vectors which will directly cause them to run into a neighbor at that agent's current location. This agent computes this vector space for a number of neighbors then chooses a vector of action towards the intersection of the borders of these collision spaces. Every other agent simultaneously makes a similar computation. In simulation, this collision algorithm behaves much like humans in crowded environments.

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Collision Avoidance Factor Comparisons:

Factor	Automotives	Planes	People	UAVs
Dimensionality Sensing	1D (Front & Back)	3D	2D	3D
Agility	Wide turn radiuses	For commercial, almost none	Highly Agile	Highly Agile
Sensing	Forward (maybe backward) facing radar	Radio broadcasts develop local maps of airspace	Sight	Direct information sharing, broadcasts (like planes), and radar
Detection	Speed differential calculation	Calculating flight trajectories of surrounding agents	Calculating flight trajectories of surrounding agents	Trajectory calculation and distance estimation (like planes); worst-case analysis is safest
Avoidance	Alert driver, charge brakes, engage brakes	Broker avoidance measures between aircraft	Calculate and anticipate safe paths around others	Geometrically calculating avoidance trajectories; visual sensors used to keep objects in view at a safe relative location; calculating potential, “force-field”