Introduction to Sense and Avoid Systems in Autonomous Drones

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Flying drones and airplanes autonomously beyond visual line of sight (BVLOS) relies on the autonomous ability to maintain safe separation from other aircrafts. While a complete solution can rely on a layered approach that includes careful planning and coordination with cooperative traffic, an on-board detect and avoid (DAA) capability is a core component. The task involves detecting and tracking other aircrafts, deciding whether an avoidance maneuver is required and selecting an appropriate maneuver.

Using a vision-based solution has clear advantages, but also unique challenges. In addition to the need to detect and track small objects from far away in a large field of view, we also need to generate the information needed for selecting an appropriate maneuver, which guarantees a significantly reduced collision risk.

Apparently, even defining the ground-truth for this problem is not trivial, as it involves assumptions on the encounter's future geometry. Direct estimation of the range or the full 3D geometry can make the avoidance decision easier, but is challenging for the vision system without making further assumptions on the size of the object. Estimation of the miss-distance and the time to the closest point of approach may be easier and sufficient. Finally, the nature of the application requires strong evidence of the system performance under all operational conditions, which is difficult to provide for computer vision algorithms trained on data.

This talk will describe the task and its unique challenges, as well as possible solution approaches.