Autonomous Visual Tracking of Unmanned Aerial Vehicles

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The DoD uses various Unmanned Aerial Vehicles (UAVs) for important missions. Communication between the UAV and the ground base is crucial, and knowing the location of the UAV is constantly needed for highly directional antennas. The goal of this research was to design and construct an autonomous tracking antenna mounted on a computer controlled pan-tilt unit that is able to keep constant communication between the ground station and the UAV. Assuming the ground station carries a camera sensor that provides a visual tracker, a velocity proportion controller between the two positions was computed. Using that vector, the pan-tilt unit rotated along both azimuth and elevation degrees of freedom. The antenna was able to point in the direction of the vehicle at all times, maximizing the signal reception. Implementing software on the ground station and leveraging the Robot Operating System (ROS) architecture, the capability to implement a visual tracker, use a velocity proportion controller, and translate the data to serial commands that the pan-tilt can understand was achieved. The system was evaluated by computing the standard error and constructing a confidence interval of the difference in the position error. The experimental results showed successful tracking of the antenna pointing in the direction of the vehicle. This system will support many research-based flight test needs in the future.