14.3 TRACKING OF SMALL UNMANNED AERIAL VEHICLES USING WEATHER RADAR

K. ORZEL[1], D. PEPYNE[1], S. TURNER[1], J. VILARDELL-SANCHEZ[1], A. BAJAJ[1], M. ZINK[1], S. FRASIER[1]

[1] University of Massachusetts at Amherst, USA

korzel@umass.edu

The Federal Aviation Administration (FAA) estimates that, by 2021, as many as six million small Unmanned Aerial Vehicles (sUAVs) or micro-drones could be in U.S. skies. This trend has been driven by the ease of regulations, availability of low-cost micro-drones, capabilities such as aerial reconnaissance and maneuverability, innovative uses of these systems, such as inspections of pipelines and utility lines, law enforcement and package delivery. At the same time, however, micro-drones increasingly have been creating problems that jeopardize public safety, business continuity and privacy concerns. Drone safety incidents, including flying improperly, or getting too close to other aircraft, now average about 250 a month. A counter-drone industry has developed around drone surveillance, or the monitoring and tracking of non-cooperative sUAVs.

The Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) at the University of Massachusetts. Amherst has pioneered the innovative use of Xband dual polarization weather radar to detect, classify and track sUAVs. Since most sUAV parts are made of carbon fiber, plastic and styrofoam, this class of drones is characterised by a very small radar cross section (RCS) between -30dBsm and -10dBsm. SUAVs exhibit a characteristic micro-Doppler signature that can be used for detection and for discrimination avian targets (birds) [Orzel et al., 2017]. Tracking drones or birds, either in software or visually on a display, also requires a very fast update rate on order of 5 seconds. This necessitates the use of next generation phased array radar.

The radar being used in this project is a Phase Spin Weather Radar (PSWR) [Orzel & Frasier, 2018]. In weather radar surveillance mode, PSWR performs a full 360 degree mechanical scan in the azimuth, while performing electronically RHI scans. This significantly limits the site revisit time. Furthermore, it is possible that drone will be located only in few range cells during the entire mission due to the fact that a weather radar range resolution is on order of 50-150 meters and many flights are limited to the visual line of sight (VLOS). Results from different drone flight scenarios will be presented and the result of a tracking algorithm will be verified using the information obtained by the UAV onboard GPS unit.

This work is supported through a U.S. National Science Foundation innovation grant.

References

K.Orzel and S.Frasier, “Weather Observation by an Electronically Scanned Dual-Polarization Phase-Tilt Radar”, IEEE Transactions on Geoscience and Remote Sensing, Volume: 56 Issue: 3, March 2018.

K. Orzel, S. Govindasamy, A. Bennett, D. Pepyne, and S. Frasier, “Detection and identification of the Remotely Piloted Aircraft System using a weather radar”, in AMS 38th Conference on Radar Meteorology, September 2017.