



PAWR Project Office

Constrained Multi-UAV Sensing: From Analytical Design to Experimental Verification on AERPAW

Mohammadreza Barzegaran – AERPAW

We present a framework in which an autonomous multi-UAV swarm jointly optimizes its deployment using onboard sensing data and information exchanged across the network to make coordinated decisions in real time. The control architecture couples a gradient-based coverage controller with a constraint-enforcing quadratic program whose constraints are derived from nonsmooth control barrier functions. The resulting controller coordinates heterogeneous UAVs while enforcing collision avoidance, geofencing, and wireless connectivity. We use the NSF PAWR AERPAW platform to translate the framework from analytical development and MATLAB simulation through code generation and emulation to field deployment. In representative experiments, two UAVs with software-defined radios operating at 3.32 GHz executed synchronized maneuvers under operational constraints. Logged trajectories closely matched simulations, while synchronized radio measurements enabled direct comparison of predicted and observed network behavior. These results demonstrate the framework's real-world feasibility and the complete AERPAW workflow from simulation to multi-UAV experimentation.