Project Skyline · Safe and Intelligent Autonomy for Aerial Delivery

Santa Clara University | Burak Kürkçü Research Group

Overview: Project Skyline is a student-led research initiative at Santa Clara University that develops safety-critical autonomy frameworks for aerial delivery systems. Our work focuses on developing verifiable, failure-resilient autopilot and perception modules that enable small drones to operate safely in human environments, such as university campuses, industrial areas, and suburban corridors. The group functions as a research laboratory for autonomous flight safety, integrating control theory, perception, and simulation-based validation.

Technical Work: Our group's digital-twin testbed supports high-fidelity six-degree-of-freedom flight dynamics and automated safety regression of new autonomy modules. The control stack includes a supervisory layer enforcing control-barrier-function constraints in real time. Multi-sensor perception integrates stereo vision, inertial measurements, LiDAR, and GPS. Each configuration is assessed through quantitative safety metrics, including probability of violation within a defined operational envelope.

Research Focus: Skyline investigates four main areas: Autopilot safety and certification readiness, obstacle detection and sensor fusion, simulation-based validation, and operational risk modeling. Our approach emphasizes redundancy in control architectures, mathematically verified safety guarantees, and robust perception under uncertain sensing conditions. Simulation environments developed in MATLAB, Simulink, and Gazebo are used to evaluate system behavior across thousands of Monte Carlo trials that model mass, wind disturbances, and sensor faults. An image of the current simulation environment is included below to illustrate the validation workflow.

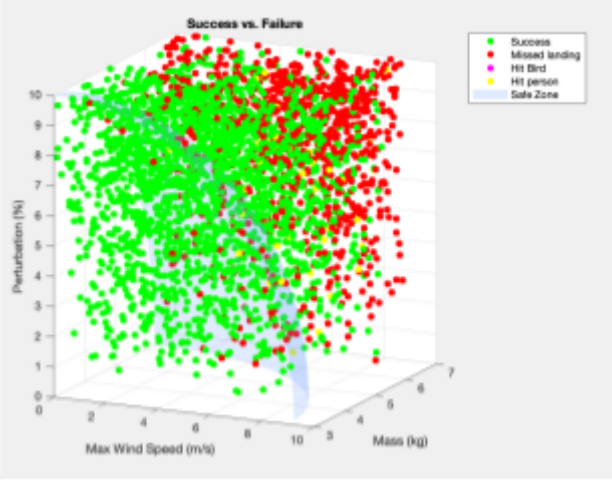

Figure 1. Results of 6,000 Monte Carlo simulations with varied mass, wind speed, and perturbation levels.

Collaboration: Project Skyline offers an academic setting for evaluating and improving autonomy modules, sensing hardware, and risk-aware flight logic. Collaboration opportunities include hardware-in-the-loop testing, comparative analysis of planning or control frameworks, de-risking autonomy components, and joint publications. The group aims to contribute reproducible research and validated data that support safer large-scale UAV operations.

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