Autonomous Assessment and Predictive Capabilities for Low-Altitude Urban Flight Operations

Wendy A. Okolo
NASA Ames Research Center, Moffett Field CA 94035

The integration of unmanned aerial vehicles in the national airspace will introduce new vehicle types, technologies, and operational paradigms for which safety must be maintained and hazards mitigated. One approach is to attempt to design for possible hazards and unsafe incidents that can occur at different phases of flight (pre-flight, in-flight, and post-flight) and during ground operations. Another is to mitigate safety incidents by implementing changes to policies, procedures, regulations, and design to cover personnel, equipment, and aircraft during operations. These and other techniques, not described herein, are typically conservative or ad-hoc in that they reduce the likelihood of risk after safety incidents have occurred. In this work, the goal is to develop a more predictive capability to monitor and mitigate risk and hazards to safety "in-time" enough for decisions to be made.

In line with NASA's Aeronautics Mission Directorate Strategic Thrust 5 [1] (In-Time System-Wide Safety Assurance), the System-Wide Safety (SWS) project under which this work falls, is developing and demonstrating innovative and safety-oriented solutions that enable modernization and aviation transformation. To that effect, this work will detail data-driven efforts on the SWS project to develop a number of safety-critical services for in-time monitoring and mitigation of hazards to low-altitude flight operations. First, hazards to these operations are identified based on previous work by NASA [2,3] and others in the aerospace industry. These hazards include (i) unsafe proximity to other vehicles, property, and people on the ground, (ii) critical system failures such as communication signal/GPS loss, unexpected propulsion system degradation, engine/power failure, and (iii) operational/environmental issues such as severe weather and gusty winds. For these hazards, safety metrics, which can be quantified and assessed are defined, models to monitor and predict them are developed, and flight test data is generated to develop, validate, and test these models, considering the complex interplay of the different hazards that define them [4-6]. In addition, the uncertainty in the non-deterministic effects that cannot be modeled nor predicted and unknown unknowns that arise after design/testing and during operations must be handled in rigorous manner. As a result, for each of the developed safety metrics, their dependencies on one another are characterized and a framework for handling the uncertainties inherent in the modeling, algorithms, and measurements required for prediction is also developed [7].

To that effect, this presentation will describe the safety metrics and services already developed and underway under the System-Wide Safety project that utilize data-driven techniques for the identification of anomalies, precursors, and trends (APTs) to monitor and mitigate hazards to safety, in-time, for urban flight operations in low-altitude airspace.

References

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