Robust Aerial Robot Autonomy and Cooperative Heterogeneous Vehicle Deployments

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The applicability of small-scale unmanned air vehicles to autonomous inspection, search and rescue, surveillance, and transport is driving rapid growth in the field of aerial robotics. Despite this growth, numerous challenges still exist for aerial robots operating in difficult environments where vehicles must robustly adapt to unknown conditions in order to ensure continued stable flight. Further, such systems are fundamentally constrained by available onboard sensing and computation resources, limiting applicable methodologies, flight duration, and system performance.

We will present recent advances in robust state estimation, control, and autonomy to enable autonomous small-scale air vehicle operation in challenging field domains toward environment exploration and mapping where vehicle performance and intent adapt in response to the uncertainty in the surrounding world. We will also discuss the role and importance of robotic cooperation in addressing the limitations of aerial robots through the introduction of additional ground and air vehicles toward enhanced system capabilities and extended operation. We will propose cooperative strategies that seek to exploit team heterogeneity to maximize individual ground and air vehicle contributions to the collective team objective and review recent field experiments that evaluate the deployment of such systems in challenging real-world environments.