Constrained Model Reference Adaptive Control with Applications to Tailsitter UAV Control Systems Design

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Over the years, model reference adaptive control has proven its ability to steer the trajectories of nonlinear plants toward the trajectory of an ideal model or a user-defined reference signal despite matched, unmatched, and parametric uncertainties. In this presentation, we will discuss recent advances in this area by presenting a model reference adaptive control law for prescribed performance, that is, a control law that, in addition to the aforementioned features, allows the user to set the closed-loop system's rate of convergence, and the bounds on the control effort. These results are then applied to the design of innovative control systems for a class of unmanned aerial vehicles (UAVs), which has drawn considerable attention in recent years, namely, tailsitter UAVs. Equipped with multiple propellers and wings, these vehicles are able to take off and land vertically and hover like classical multi-rotor UAVs (*e.g.*, quadcopters) and fly over distances that are considerably longer than those covered by their classical multi-rotor counterparts. Several challenges hinder the control design problem for these vehicles, ranging from the nonlinearity of their dynamic and aerodynamic models, the need to avoid unwinding, the substantial uncertainties in the underlying models, and the need to exploit both wings and propellers to track arbitrary user-defined reference trajectories.

Bio: Dr. Julius Marshall (Member, IEEE) is an industrial engineer with the Naval Air Warfare Center Aircraft Division at the Naval Air Station, Patuxent River. He received his B.S. degree in Aerospace Engineering at the University of Oklahoma, Norman OK, in 2018. He was awarded the Science, Mathematics, and Research for Transformation (SMART) scholarship in 2019. He received his Ph.D. in Industrial & System Engineering from Virginia Tech, Blacksburg VA, in 2022. His current research interests include adaptive control, nonlinear control, artificial intelligence, and unmanned aerial systems.