

Piloting on the Edge: Approaches to Flight Control Solutions

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Abstract—Flying near the edge of the safe operating envelope is an inherently unsafe proposition. Space missions, especially one-of-a-kind missions in which uncertainties are common, need technologies that can sustain flight at the "edge" of the stability and performance envelope of the spacecraft. Edge of the envelope here implies that small changes or disturbances in system state or system dynamics can take the system out

safe flight in the midst of either greater uncertainty or greater needed performance than originally planned is non trivial. In this paper, we outline two novel control concepts that are well suited for enabling edge of the envelope flight. The outlined technologies work with both piloted and autonomous applications.

Index Terms—adaptive estimation, data-based predictive control, flight safety envelope;

of the safe envelope in a short time and could result in catastrophic failures. Performance that fully exploits available resources to maintain