Cross-Track Control of Fixed-Wing UAS Using Passivity Based Techniques

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Abstract: The paper addresses the time-varying directional stabilization problem for a small, fixed-wing unmanned aerial system with one control thrust and three control moments about the roll, pitch, and yaw. The nonlinear control law makes use of the passivity property gained from modeling the aircraft as a port-Hamiltonian system. The static state feedback control law is designed following an energy-shaping approach to leverage the open-loop system's port-Hamiltonian structure in order to construct a control Lyapunov function. The proof requires basic assumptions of aerodynamic forces and moments rather than explicit formulae and shows asymptotic stability of the desired flight condition within a sizeable region of attraction. The directional stabilization algorithm is then extended by including a line-of-sight guidance law and varying the direction as a function of position instead of time. The resultant control law and associated proof follow similarly to that of the time-varying directional stabilization problem.

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