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Formal Asymptotic Stability Guarantees, Analysis, and Evaluation of Nonlinear Controlled Unmanned Aerial Vehicle for Trajectory Tracking

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Abstract : This paper concerns with the formal asymptotic stability guarantees, analysis and evaluation of a nonlinear controlled unmanned aerial vehicles (uav) for trajectory tracking purpose. As the system has been recognised as an under-actuated non linear system, the control strategy has been oriented towards a hierarchical control. The dynamics of the system and the mission purpose make it mandatory to provide an absolute proof of the vehicle stability during the maneuvers. For this sake, this work establishes the complete theoretical proof for an implementable control oriented strategy that asymptotically stabilizes (GAS and LISS) the system and has never been provided in previous works. The considered model is reorganized into two partly decoupled sub-systems. The concidered control strategy is presented into two stages: the first sub-system is controlled by a nonlinear backstepping controller that generates the desired control inputs to stabilize the second sub-system. This methodology is then applied to a harware in the loop uav simulator (SiMoDrones) that reproduces the realistic behaviour of the uav in an indoor environment has been performed to show the efficiency of the proposed strategy.

Keywords : UAV application, trajectory tracking, backstepping, sliding mode control, input to state stability, stability evaluation
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