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Adaptive Attitude Control for Foldable Quadrotors

Background

Recent designs for quadrotors have focused on improving mechanical feasibility, including foldable and reconfigurable bodies. Foldable quadrotors, for example, are capable of flying through small openings and cluttered spaces. However, there has been limited research conducted on the tracking performance of the quadrotor during in-flight configuration switching.

The low-level flight control for a foldable quadrotor is challenging due to differing dynamics depending on the configuration. Many current designs consider bounded model uncertainties, which are held constant across the various configurations and can lead to chattering in the control inputs. Adaptive controllers that switch between various operating configurations have also been developed, but they assume precise knowledge of vehicle model.

Invention Description

Researchers at Arizona State University have developed an adaptive controller composed of a parameter estimation law and a robust term for foldable quadrotors. This controller relies upon analysis conducted through a novel adaptive framework for analyzing the dynamics of foldable quadrotors by modeling them as switched systems. This framework derives the necessary dwell-time requirements for guaranteeing asymptomatic stability of the attitude tracking errors in the presence of bounded disturbances. This results in a control-aware trajectory planner to achieve stable flights during switching.

Potential Applications

- Delivery (e.g., cargo, consumer products)
- Surveillance & aerial photography
- Land surveys & crop assessment

Benefits and Advantages

- Stable flights during configuration switching
- Reduces tracking errors in the presence of bounded disturbances
- Improved modeling and control of flight parameters

