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Title: Investigating the Effects of Polynomial Trajectories on Energy Consumption of Quadrotors

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Abstract: This article focuses on investigating the effect of quadrotor's trajectory, especially polynomial trajectories, on its energy consumption. First, model-free expressions for power and energy quotients are introduced to relate quadrotor's power and energy directly to its acceleration. This allows to qualitatively estimate quadrotor's energy consumption and compare the effect of different trajectories on energy consumption of identical or different quadrotors independent of quadrotor's manufacturing specifications. Then, polynomial trajectories are analytically investigated for rest-to-rest 1-D scenarios. Scenarios in 3-D with arbitrary kinematic boundary conditions are analyzed via Monte Carlo Simulations with a sample of 10 000 sets of arbitrary boundary conditions. Polynomial trajectories are compared to energy-minimized trajectories in the literature. The results show that increasing the degree of the polynomial increases quadrotor's energy consumption. Moreover, this article suggests using minimum acceleration trajectories as energy-efficient polynomial trajectories. Finally, the results are validated experimentally.