

Abstract: Most spacecraft require accurate pointing capabilities for solar power generation, imaging, or communication and would benefit from a control system able to adapt to variation within the spacecraft. Previous attitude control studies have examined adaptive control laws and fault-tolerant control (FTC) but have often neglected the effect of actuator failure and degradation. Existing adaptive methods focus on the initial tuning of the control law, not the integrity of the control law itself. From the literature, this work identifies several key requirements that would be met in an ideal fault-tolerant, adaptive spacecraft attitude controller, all centered around increasing tolerance to actuator non-idealities and removing reliance on unknown quantities. While neural networks may be applied to this problem, both speed and resiliency to overtraining make lazy learning with regression more apt to provide the necessary adaptive behavior and long-term fault-tolerant control. A recent work by the author investigated an initial implementation of lazy learning with regression to attitude control but its querying method could be improved. This study seeks to extend these past methods and better understand the application of lazy local learning to attitude control by characterizing the effect of bandwidth and the number of training points on the system's performance. The work resulted in a more robust implementation of linear regression on the training data points using the normal equation as well as an application of locality sensitive hashing which preserves interdependency between rotation axes when querying the local learning training set. Running C-based flight software within NASA's 42 simulation framework, the experiment showed that in nominal operating scenarios, the actuator input/output relationship is linear. Once enough information is available to capture this linearity, additional training data and differing bandwidths did not significantly affect the system's performance with a standard PID control law. However, this linearity may not remain if actuators degrade or fail. Therefore, future work should include investigating the

performance of the improved algorithm in off-nominal scenarios and over longer mission durations.