An Investigation Into Active Control for Accessible Orbital Flight

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Recently, a new, practical and publicly accessible satellite standard called the SmallSat has amplified public involvement in orbital research. This allows for flexible and efficient deployments of impactful low-earth-orbit experiments that would otherwise never be flown. However, the launch industry responsible for flying these experiments is not flexible nor efficient. This project aims to make orbital technologies accessible at the miniature scale, specifically thrust-vector-control, through an iterative engineering process simplifying and miniaturizing technologies from launch vehicles such as the Space Shuttle and Falcon 9. An Arduino-based custom flight computer was developed alongside state machine control software and active-control hardware, all designed to scale. Together, these three major components emulate the methods used in the aerospace industry. Initial test flights and recent ground test data have indicated stable control with a maximum of 7° and 2.62° of deviation from the intended flight path respectively, an acceptable stability range when compared to similar finned flights. Results show that scalable thrust vectoring is possible at a small scale, giving a level of adaptability and control never before seen in model rockets. Future research will involve high-power flights in the upper atmosphere and serve as another stepping stone in the development of personal orbital launch vehicles. With accessible orbital flight, countless experiments can be completed concurrently, allowing humanity to move forward as a spacefaring species faster than ever before.