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## HARDWARE-IN-LOOP STAR TRACKER EMULATOR

**Abstract**

As star trackers currently provide the most accurate attitude estimation to satellites, the electronics and algorithms are constantly evolving to produce star trackers with decreased cost, size and power requirements while providing better accuracies. An emulation environment was developed and tested in this project that enables hardware-in-loop emulations with a star tracker. The emulation environment provides a more convenient alternative than the need to capture the night sky to test the efficiency of certain software algorithms on star trackers to evaluate accuracy and execution time improvements provided by upgraded electronic components and software algorithms. Star projection software written for this project projects stars onto a computer monitor that simulates real stars captured in the night sky. The star images that were projected were generated with average boresight angle errors of about 2.5 arcseconds and average boresight rotation errors of only 1.5 arcseconds. The emulation environment was demonstrated by performing Hardware-in-Loop emulations with a commercial CubeSat star tracker and showed attitude estimation accuracies of boresight angular errors below 0.1 and boresight rotation errors below 0.067 for stationary stars. For stars projected with constant angular rates of up to 0.25 /s on each axis the star tracker showed that it could track the attitude with estimation errors of average boresight angular errors below 0.15 and average boresight rotation errors below 0.1. Although the star tracker performed more accurate under real night sky conditions, the emulator allows functional testing under more convenient lab conditions.