The Frequency and Modal System Identification of the Balloon-borne Imaging Testbed
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The Balloon-borne Imaging Testbed (Bit) telescope is scheduled for launch by September 2015 with the goal of demonstrating a pointing accuracy of 50 milliarcseconds. Bit is to be launched from the newly constructed Canadian Space Agency launch facility in Timmins, Ontario to an altitude of 40 km where it will remain for several hours. The structural and the controls design of the telescope must allow the on-board telescope to maintain a constant attitude for an extended period of time during which the telescope gondola is subjected to dynamical forces such as turbulence and wind shear. Due to the high level of pointing accuracy required, oscillations created by frame resonances of the telescope gondola can prove detrimental to the resulting image quality. The development of a modal analysis method for the Bit gondola is explored in this thesis. This method combines simulation results with measurement results to identify the modes of the system. For the Bit gondola’s external frame, the four lowest natural frequencies are identified to be approximately 34.5 Hz, 40.9 Hz, 47.7 Hz, and 79.2 Hz. Their corresponding mode shapes are also fully identified. The mode shapes were generated using SOLIDWORKS SIMULATION and were compared with measured values through amplitude ratios. The frequencies were generated from the peaks in the amplitude vs. frequency curves derived from the physical measurements, which were collected using analogue accelerometers placed throughout the gondola. If successful, Bit will represent a new generation of balloon-borne telescopes that can produce measurements and images comparable to those of space telescopes but at significantly lower costs.

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