Proposed Title:
Laser Tracker Utilization Methodology in Measuring Truth Trajectories for INS Testing on 6 Degree of Freedom Table at the Marshall Space Flight Center's Contact Dynamics Simulation Laboratory with Lessons Learned

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Proposed Abstract:
When performing Inertial Navigation System (INS) testing at the Marshall Space Flight Center's (MSFC) Contact Dynamics Simulation Laboratory (CDSL) early in 2017, a Leica Geosystems AT901 Laser Tracker system (LLT) measured the twist & sway trajectories as generated by the 6 Degree Of Freedom (6DOF) Table in the CDSL. These LLT measured trajectories were used in the INS software model validation effort. Several challenges were identified and overcome during the preparation for the INS testing, as well as numerous lessons learned. These challenges included determining the position and attitude of the LLT with respect to an INS-shared coordinate frame using surveyed monument locations in the CDSL and the accompanying mathematical transformation, accurately measuring the spatial relationship between the INS and a 6DOF tracking probe due to lack of INS visibility from the LLT location, obtaining the data from the LLT during a test, determining how to process the results for comparison with INS data in time and frequency domains, and using a sensitivity analysis of the results to verify the quality of the results. While many of these challenges were identified and overcome before or during testing, a significant lesson on test set-up was not learned until later in the data analysis process. It was found that a combination of trajectory-dependent gimbal locking and environmental noise introduced non-negligible noise in the angular measurements of the LLT that spanned the evaluated frequency spectrum. The lessons learned in this experiment may be useful for others performing INS testing in similar testing facilities.