

# Axient's End-to-End Solutions for In-Space Docking and Berthing

## JSC Six-Degree of Freedom Dynamic Test System (SDTS) Program Spotlight

## Executive Summary

Axient boasts a rich history spanning several decades in supporting spaceflight docking and berthing operations. Our Subject Matter Experts (SMEs) have developed operational software and simulation emulators for both the Marshall Space Flight Center's (MSFC) Contact Dynamics and Simulation Lab (CDSL) and the Johnson Space Center's (JSC) Six-Degree of Freedom Dynamic Test System (SDTS) 6-DOF platforms. Our expertise encompasses the Common Berthing Mechanism (CBM), CBM qualification via the Resistive Load Simulation (RLS), the Hubble Soft Capture Mechanism, the Light Impact Docking System (LIDS), the International Light Impact Docking System (iLIDS), and the development of the NASA Docking System. We have provided support to Commercial Crew providers with detailed, physics-based models of their docking systems and have been at the forefront of designing the HLS Docking System.

## End-to-End Support

- Generating conceptual drawings from initial ideas
- Prototyping with Commercial Off-The-Shelf (COTS) Model-Based Design (MBD) software
- Conducting Monte Carlo analysis using our proprietary C-based LAMBDA multi-body dynamics tools
- Planning and executing 6-DOF tests
- Correlating simulation results with test data
- Drafting Verification and Hazard Analysis Reports to support certification processes

## Solutions

- Docking SME Support
- Monte Carlo Analysis, Verification, and Hazard Analysis
- Implementation of a Variable Preload Helical Cam Docking Mechanism
- Development of an Advanced Apollo Probe and Cone Assembly System

- Developed by Dynamic Concepts LLC (DCI), Axient equipped the SDTS facility with a sophisticated physics engine that processes real-time sensed forces, applies these forces to a predefined mass property, and calculates the required leg lengths for the 6-leg Stewart Platform, thus outputting precise commands.
- We have broadened the system's capabilities by incorporating several forms of "energy-gain" compensation. This advanced feature significantly mitigates the impact of system and actuator delays.
- Furthermore, an all-encompassing physics model of the entire SDTS facility was developed. This model accurately represents the dynamics of the SDTS, enhancing the fidelity of simulations and tests.

## HLS Support

Conceived and developed by Dynamic Concepts LLC (DCI), Axient was instrumental in establishing the foundational design concept for Human Landing System (HLS) docking system:

- We provided extensive modeling and simulation support to refine and validate the design.
- Our team designed and executed a series of component and sub-system tests to ensure model accuracy and reliability.
- Axient played a key role in supporting full-scale testing at the Kinematic Docking Test System, further demonstrating our commitment to precision and excellence in aerospace engineering.