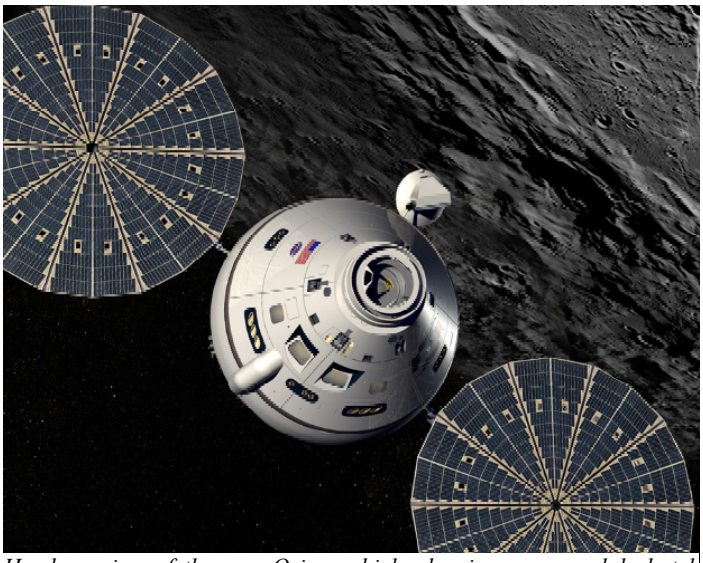
Low Impact Docking System (LIDS)

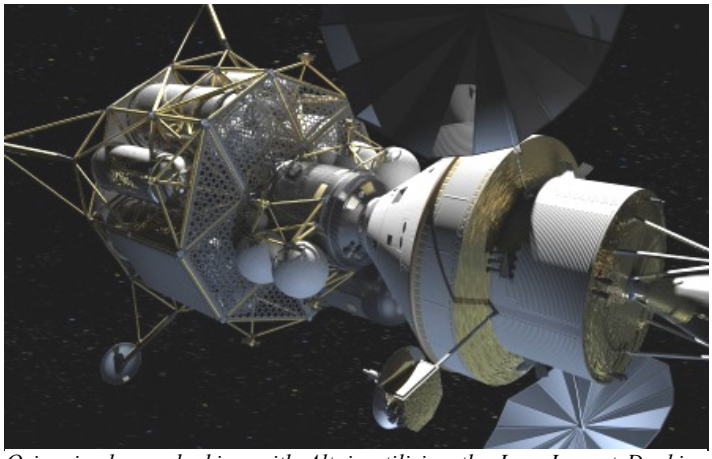
By Tobie LaBauve

The LIDS team is currently made up of approx. 65 team members that work in the NASA JSC community. The LIDS project also takes advantage of the technical expertise, resources, and testing facilities at four NASA centers and various contracting organizations. The LIDS team has the benefit of calling on the experience of its team members with backgrounds in electrical and mechanical design as well as project support, testing, systems eng., and manufacturing. The team is built around the existing core LIDS project personnel. The core team has spent over 10 years performing development work in support of a next generation docking system.

Since 1996, NASA has been developing a docking system that will simplify operations and reduce risks associated with mating spacecraft. This effort has focused on developing and testing an original, reconfigurable, active, closed-loop, force-feedback controlled docking system using modern technologies. The primary objective of this effort has been to design a docking interface that is tunable to the unique performance requirements for all types of mating operations (i.e. docking and berthing, autonomous and piloted rendezvous, and in-space assembly of vehicles, modules and structures). The docking system must also support the transfer of crew, cargo, power, fluid, and data. As a result of the past 10 years of docking system advancement, the Low Impact Docking System or LIDS was developed.



Head on view of the new Orion vehicle showing crew module hatch surrounded by the Low Impact Docking System



Orion is shown docking with Altair utilizing the Low Impact Docking System (LIDS)

The current LIDS design incorporates the lessons learned and development experiences from both previous and existing docking systems. LIDS feasibility was established through multiple iterations of prototype hardware development and testing. Benefits of LIDS include safe, low impact mating operations, more effective and flexible mission implementation with an anytime/anywhere mating capability, system level redundancy, and a more affordable and sustainable mission architecture with reduced mission and life cycle costs.

In 1996 the LIDS project, then known as the Advanced Docking Berthing System (ADBS) project, launched a four year developmental period. At the end of the four years, the team had built a prototype of the soft-capture hardware and verified the control system that will be used to control the soft-capture system. In 2001, the LIDS team was tasked to work with the X-38 Crew Return Vehicle (CRV) project and build its first Engineering Development Unit (EDU). Due to budget cuts, the

X-38 project was halted with the EDU only 60% complete. Over the next several years, the future of LIDS was unsure, but the project was able to continue its work to refine and develop the docking system design. In 2005, the LIDS team was called upon to assess LIDS applicability to meet the anticipated Orion vehicle docking scenarios.

LIDS Development History:

- 1996-2000
  - Prototype soft-capture system hard-ware and control system electronics built and test verified
  - Dynamic tests of the soft capture system completed successfully
  - Closed-loop force feedback soft cap-ture control system design validated
  - Verified interface forces (docking and berthing ops)

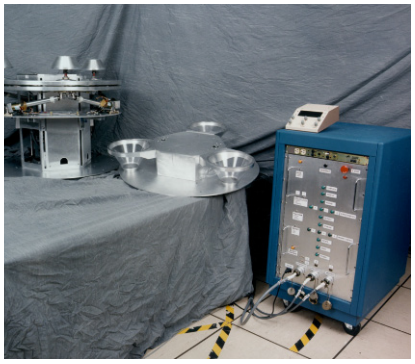
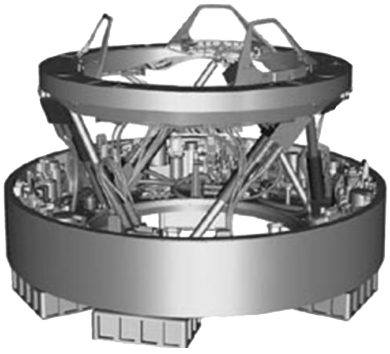


Figure 1Prototype LIDS hardware and control system

- 2001-02 (X-38/CRV)
  - Tasked with designing a 54 in. OD Engineering Develop- ment Unit
  - Project halted at ~60% complete due to funding

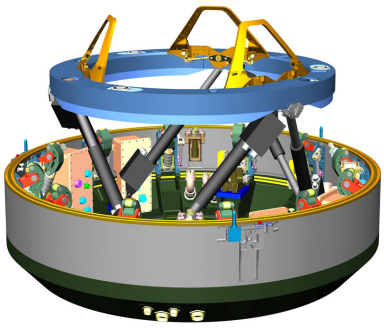
X-38 EDU testing at the Bldg 9 6DOF Facility

- 2002-03 (SLI/OSP)
  - Requirement de-veloped and trade studies performed to support the LIDS concept
  - Prime Contractor and Program support
- 2004-2005 (ESMD/ESR&T)
  - In-house technical maturation of the project commenced
  - Objective: LIDS to meet Tech-nology Readiness Level 6 (TRL6) in 4 years
- 2006 (Cx/CEV and HST)
  - Gradual phasing in of additional ESCG resources to support EDU design
  - 54 in. OD EDU soft capture mechanism assembly complete
  - 54 in. OD EDU hard capture mechanism design complete



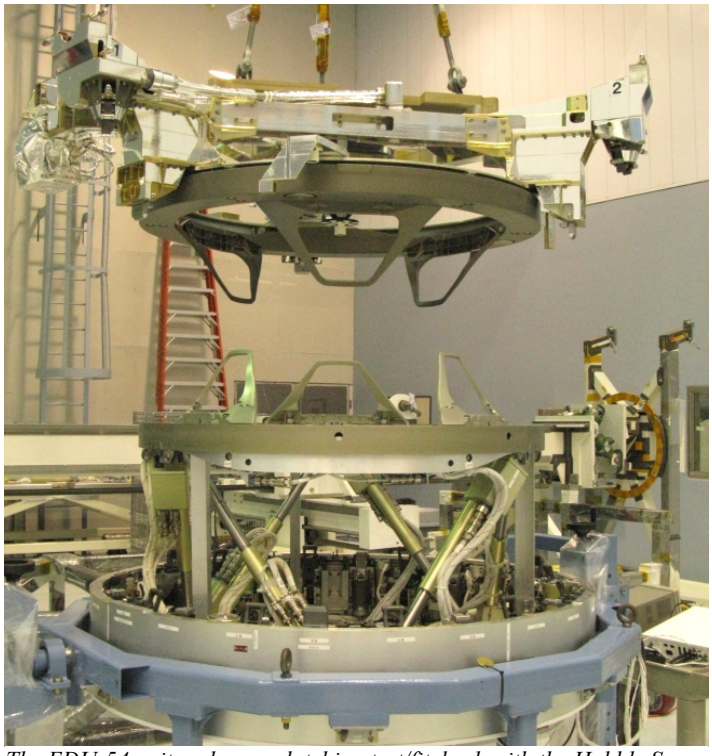
LIDS EDU-54 Model

  - Decision made to use LIDS for Cx/CEV
  - Decision made to use LIDS as the vehicle interface for HST/SM4
- 2007-present (Cx/CEV and HST)
  - Complete build-up of the 54 in. EDU Assy
  - Deliver HST flight hardware to support '09 Shuttle mission
  - Successfully com-plete LIDS major project milestones (SRR and PDR)
  - Continue develop-ment of the 58 in. EDU LIDS design



LIDS EDU-58 Model

The LIDS HST Passive Interface will function as the primary means of capture during future Hubble missions after the end of the Shuttle Program. These future missions include the HST end-of-life de-orbit mission as well as potential future servicing missions. Currently, HST servicing is accomplished by Shuttle Remote Manipulator System (SRMS) grappling and berthing of the HST onto a Soft Capture Mechanism (SCM) mounted on top of the Flight Support System (FSS) in the Orbiter payload bay. During HST Servicing Mission 4 (SM4), currently targeting the May 2009 STS-125 Shuttle mission, the SCM will be left attached to the HST with the passive LIDS docking interface exposed on the HST aft bulkhead for future use.



The EDU-54 unit undergoes latching test/fitcheck with the Hubble Space Telescope (HST) Soft Capture Mechanism (SCM) at Goddard Space Flight Center (GSFC)