

AGI USER EXCHANGE

EAST • WEST 2006

Safe Rendezvous and Proximity Operations

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Emergent Space Technologies





Company Overview

- We provide engineering services and consulting to the civil, commercial, and military space industry
- Our core competencies include:
 - Spacecraft guidance, navigation and control
 - Command, control, and information systems
 - Mission operations automation and autonomy
- We became an AGI business partner in 2006
 - Focusing on systems integration of AGI products
 - Real-time implementations of ODTK, STK, etc.



Background

- **Founded August 2001**
 - 100% growth per year since inception
- **Headquartered in Greenbelt, Maryland**
 - Planning for expansion to Colorado and Texas
- **Highly educated workforce**
 - 30% PhD, 30% MS, 40% BS
- **Experienced in multi-satellite development and operations**
 - Globalstar, Iridium, HST HRV, ANGELS, EO-1/LS-7, SMEX
- **Diverse customer base**
 - NASA, NOAA, Air Force, DARPA, Private Industry
 - Cleared for DoD work
- **Prime contractor partners**
 - Lockheed Martin, Orbital Sciences, Northrop Grumman, Honeywell Technical Services, Swales Aerospace, General Dynamics, SpaceDev



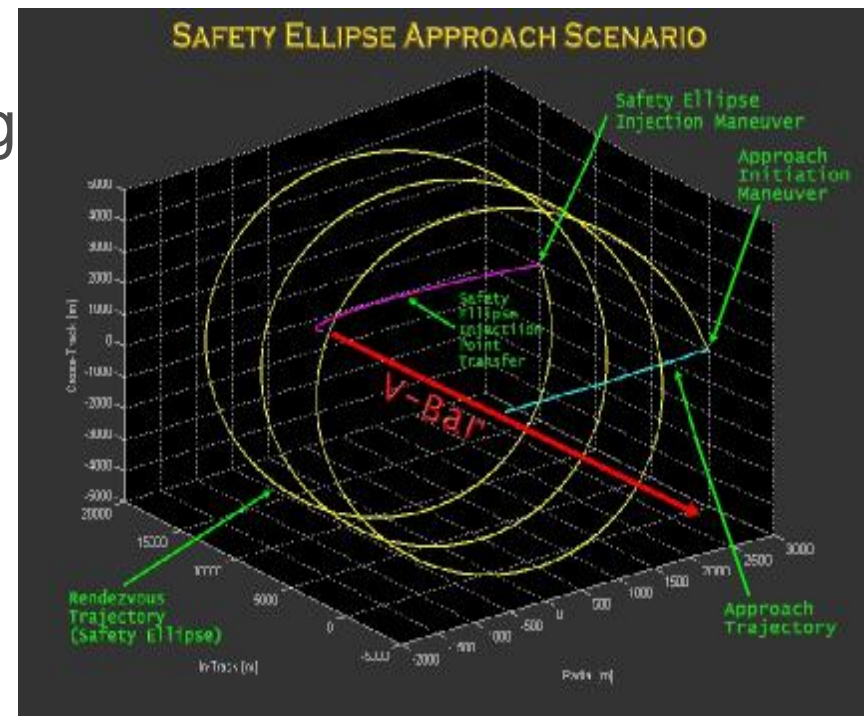
Program Overview

- Commercial Orbital Transportation Services (COTS)
 - Supported the SpaceDev Team
 - On-Orbit Navigation and Rendezvous and Proximity Operations
 - SpaceDev's Dream Chaser (DC), a variant of NASA's HL-20 lifting body, is the proposed crew/cargo transfer vehicle
 - With the International Space Station (ISS) as the destination, safe rendezvous and proximity ops are paramount
 - Emergent developed algorithms for safe DC/ISS rendezvous and proximity operations and used high-fidelity modeling and simulation to visualize their performance



Challenge

- Compute safe approach maneuvers for DC/ISS approach, prox ops and docking
- Interface in-house algorithms with AGI software for visualization
- Create animation of approach trajectories and docking
 - Using SpaceDev-provided model
 - Displaying a “keep out” ellipsoid
- Do this rapidly since we were on a tight schedule





Solution Criteria

- Provide visualization as rendezvous trajectories are computed
 - Ability to accept maneuver data from in-house software
- Display relative trajectory between ISS and DC
- Utilize accurate spacecraft models and textures
- Display ISS “keep out” ellipsoid
- Intuitive user interface for rapid development



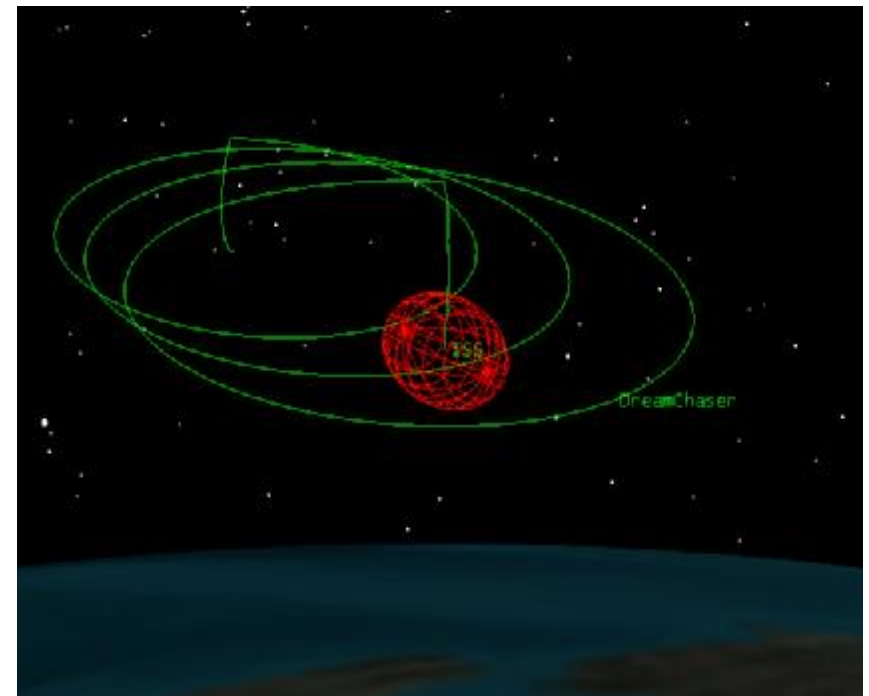
Alternative Solutions

- **Celestia**
 - Only provided visualization
- **In-House visualization software**
 - Too much time required for development
- **STK product suite**
 - Provides clean interface for quick integration
 - Provides excellent graphical displays
 - Provides means to generate post-simulation movies for marketing purposes



Solution

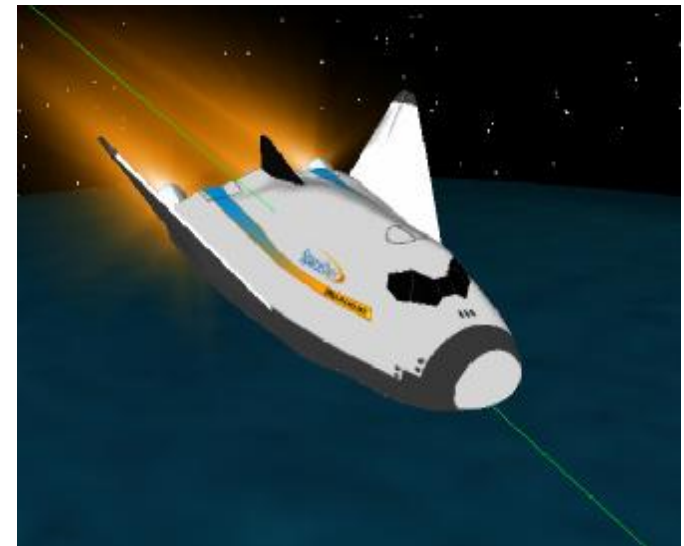
- STK/Advanced VO
 - Provides accurate visualization of proximity operations and docking
 - Accurate models and textures
- STK/Connect
 - Provides interface with in-house algorithms
 - Easy to use and implement in a short development period
- STK/Astrogator
 - Provides multiple maneuver propagation capability
- ODTK for future work
 - Provides navigation algorithms





Results

- Time Savings
 - In-House
 - Customer model conversion: 10 hours
 - In-house visualization software development: 120 hours
 - Interface with in-house algorithms: 40 hours
 - Capture animation: 25 hours
 - **Total Hours: 195 hours**
 - STK/In-House
 - Customer model conversion: 15 hours
 - In-house visualization software development: 0 hours
 - Interface with in-house algorithms: 10 hours
 - Capture animation: 20 hours
 - **Total Hours: 45 hours**
 - **Total Savings: 150 hours**



* Numbers are approximate



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