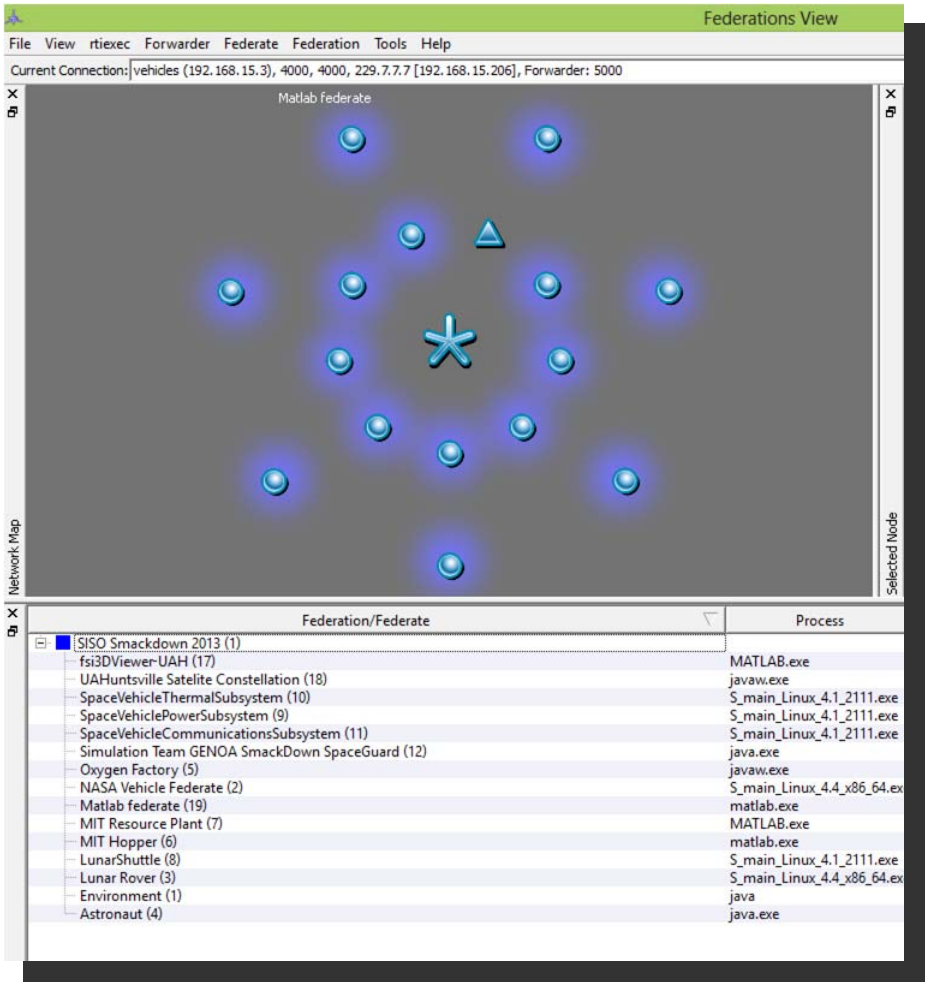
# *Simulation Smackdown 2013*

## Debriefing

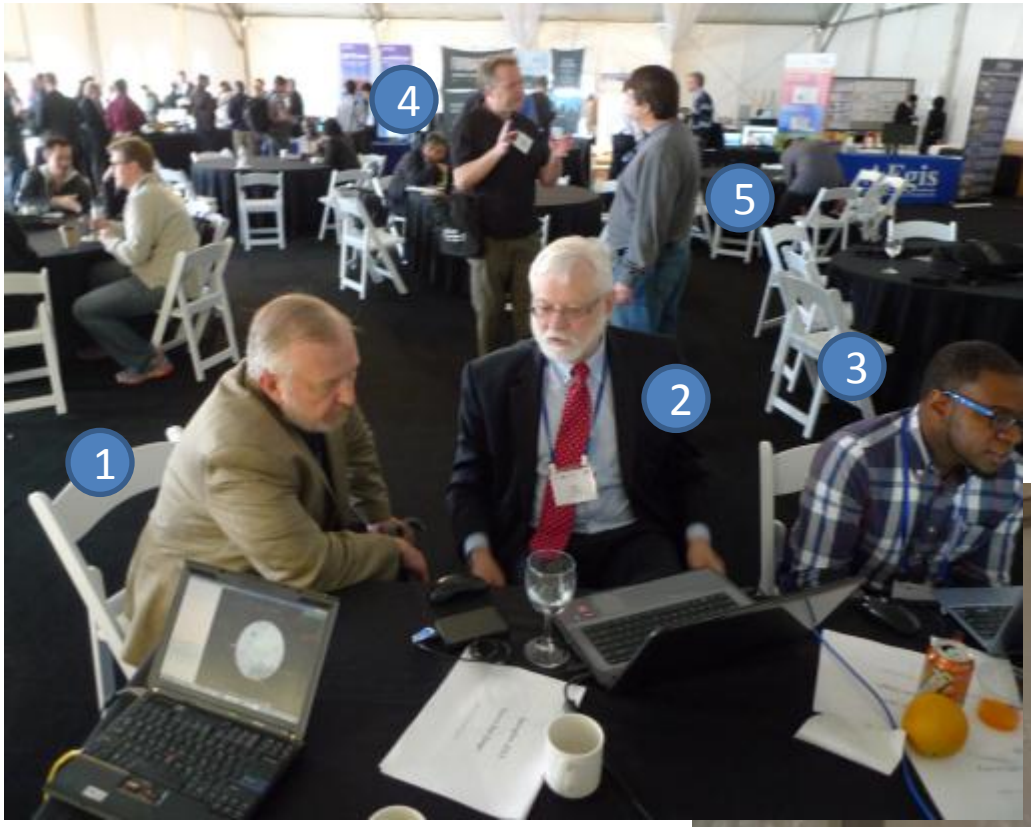
Daniel O'Neil

April 19, 2013




*Screenshot of the MAK Federation*

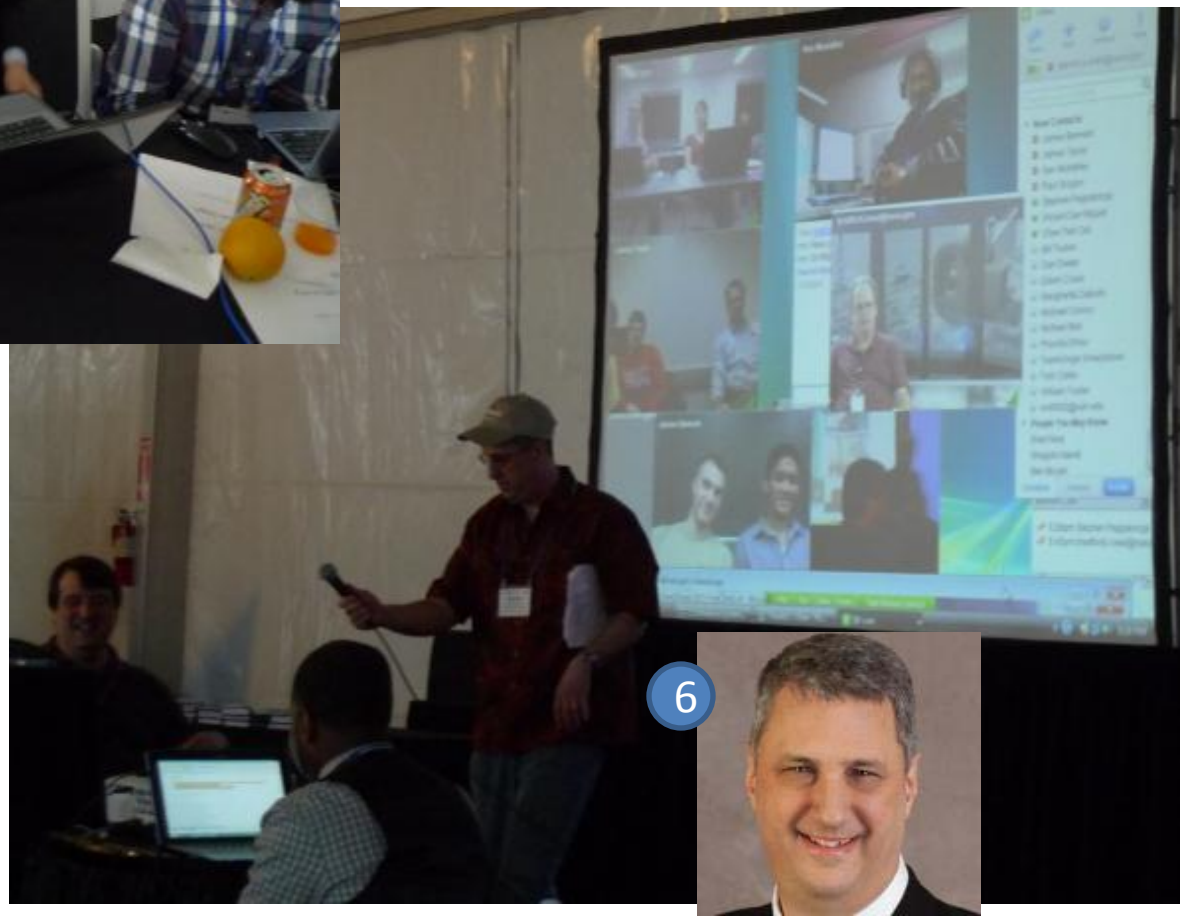
Back of the Cover Page




Photographs by Binyang Wei

**Venue**: A walled tent in the parking lot of the Bahia Resort in San Diego

1. Bill Wait, cofounder of Aegis Technologies
2. Bill Tucker, UAHuntsville Team Leader
3. Tymaine Whitaker, SAIC , computer graphics
4. Professor Simon Taylor, Brunel University
5. Daniel O'Neil, Technical Committee Chairman
6. Steve Swenson, Aegis, Master of Ceremonies




**Remote participants via VSee:**

- Kennedy Space Center
- Penn State

(ZuQun Li attended in person)

- University of Nebraska
- Exeter University in the UK
- MIT

# The Audience

**April 9, 2013 Start time** - 5:30PM Pacific/1:30AM UK


1. Professor Mikel Petty – Faculty Advisor for the UAHuntsville Team
2. James Brucato – Currently working with Professor Dov Dori at Technion University in Israel
3. Dannie Cutts, Aegis Technologies.

Photograph by Bingyang Wei

Technical Coordinator:
Daniel O'Neil

# Simulation Smackdown 2013

April 9th, 2013 San Diego

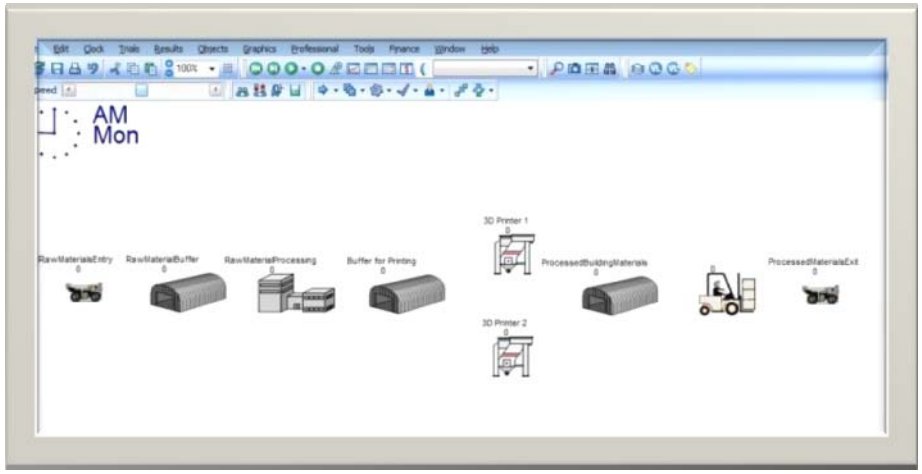
Screenshot of the Pitch Web-view that presents the simulation federation.


- Penn State – Lunar Shuttle cargo lander and subsystems: Power, Thermal, Communications
- Exeter & Brunel, United Kingdom – Oxygen Factory
- Munich University, Germany – L2 Outpost
- University of Genoa, Italy – Iphitos, a.k.a, Space Guard asteroid defense system
- MIT – Astronaut, Mobile Resource Plant, and Exploration Hopper
- Nebraska – Inherited a LunarRover cargo transport vehicle, operated by JSC due operating system issues
- UAHuntsville – Communication satellite constellation, a Lunar Mass Driver, and a visualization federate that streamed telemetry data to a program developed by KSC
- JSC provided the network infrastructure
- KSC participated via VSee video conferencing and provided a 3D visualization program developed with the Unity 3D game engine

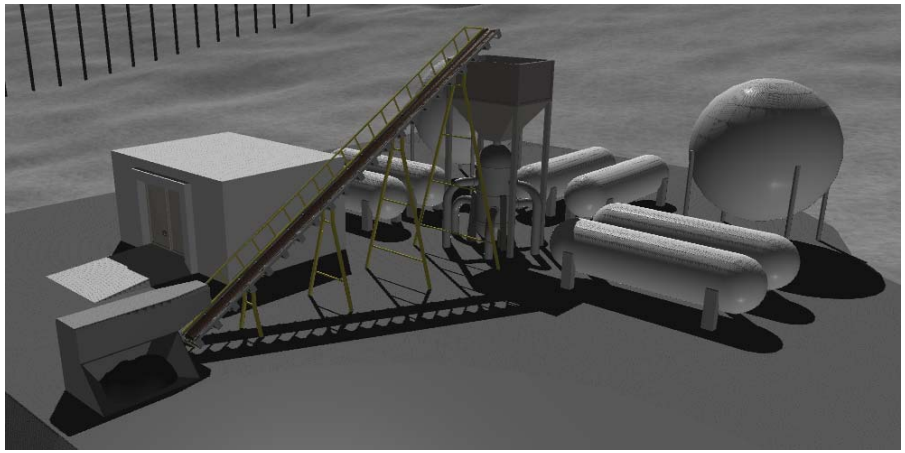
2014 Name Change: Simulation Exploration Experience

# Lunar Fabrication Factory Simulation Federate

a.k.a. Oxygen Factory




Screenshot of Simul8 simulation



Model created by KSC Team

Displayed in The Unity Tool (TUT)

## ***Brunel Exeter Team:***

- Dr Simon J E Taylor (Brunel, UK)
- Dr Navonil Mustafee (Exeter, UK)
- Anastasia Anagnostou
- Athar Nouman

Interactions with astronaut federation (MIT) (Picking up oxygen from LFF)

Subscribed interactions Published interactions

(a) ReadyToEnterExit (d) EnterExitAccepted

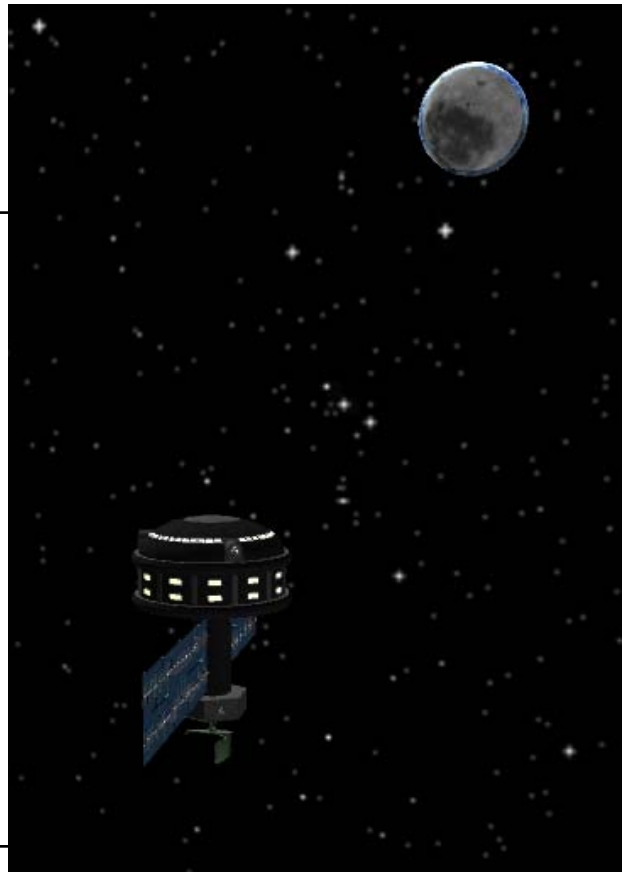
(b) ResourceTransferSpecificRequestScalar (e) ResourceTransferSpecificRequestConfirmScalar

(c) ResourceTransfer

# Lagrange Point #2 Outpost Federate

## *Munich University Team*

| | | |
|---|---|---|
| Team leader | Immanuel Neumann | Federate programming<br>Installation and<br>overall Communication |
| Team members | Greg Yeutter,<br>Drexel University | Federate programming,<br>Installation |
| | Oliver Neumann | Definitions of interaction parameters |
| | Sebastian Edelhäuser | Graphical Model<br>Structural modeling |
| | Stefan Richter | Definitions of interaction parameters<br>Visualization of L2 Outpost |
| | Sylvia Menz | Graphical Model<br>Team representation |
| Associate Team Members | Andreas Lengas, Greece<br>Rodrigo Torres, Mexico | Orbital Mechanics |



3D model by KSC team

- L2-Outpost federate code developed in Matlab
  - Forwardsim and MIT provided example code
- Orbital Mechanics and Attitude Dynamics developed in Matlab Simulink

# IPHITOS - Spaceguard

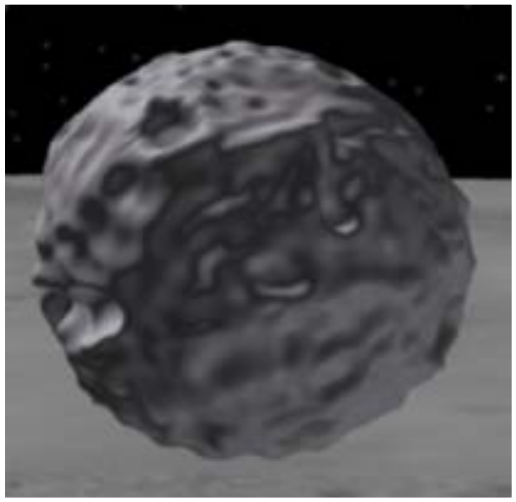
**Interoperable Simulation of a Protection solution based on ligHt Interceptor Tackler operating in Outer Space**

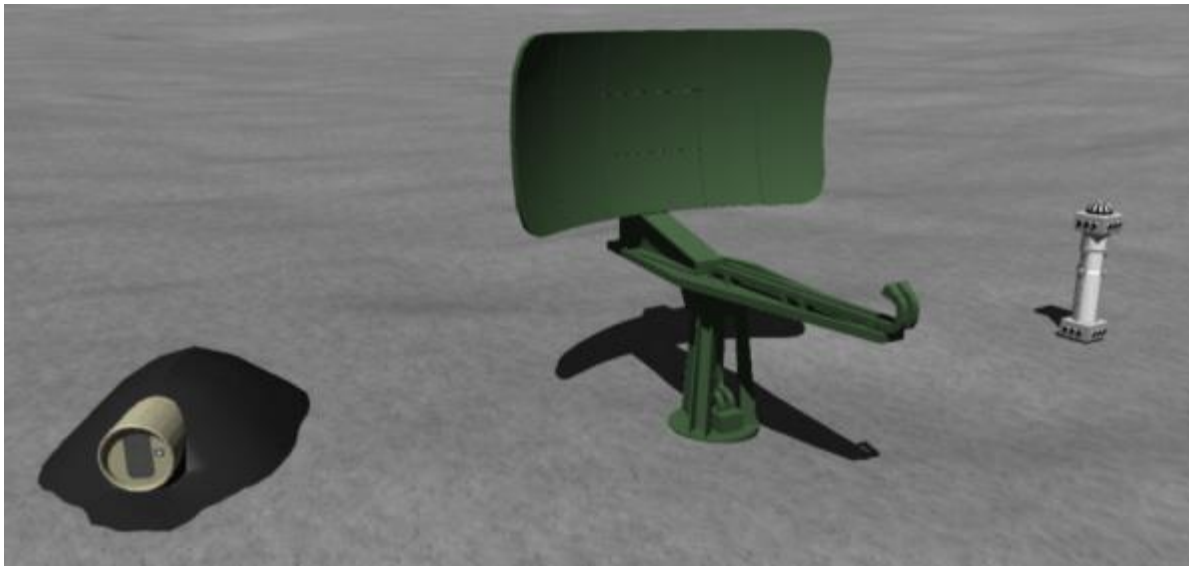

**University of Genoa Team**

- Margherita Dallorto
- Davide Poggi
- Angelo Ferrando
- Luciano Dato
- Giulio Franzinetti


Spaceguard consists of tracking small objects and asteroids that represents a threat for the lunar base. The federate include the simulation of **threats**, **control system** and **interceptor.**

ITALY





Graphics models developed by KSC team

# Astronaut, Scouting Hopper, and Mobile Resource Plant Federates

## *MIT Team*

**Paul Grogan (Mentor)**
PhD Candidate, Engineering Systems

**Tom Coles (Mentor)**
PhD Candidate, AeroAstro

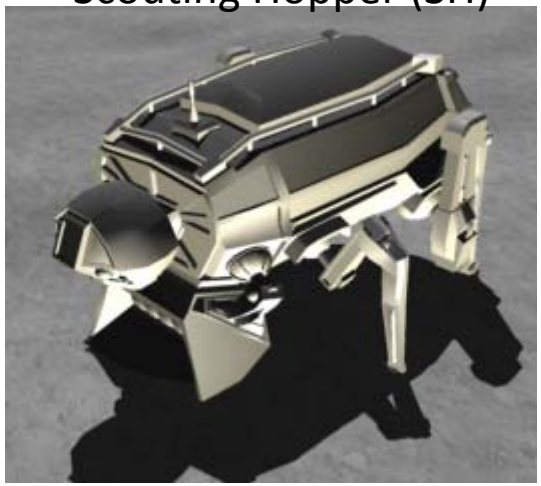
**Elizabeth Qian** Junior, AeroAstro
- Astronaut federate development & testing
- Federate ambassador specialist

**Norman Cao** Sophomore, AeroAstro
- Astronaut federate development
- Coordinate transform specialist

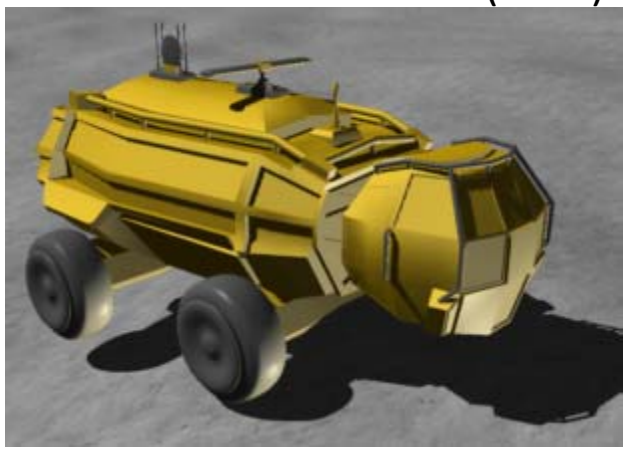
The Astronaut class is an instance of PhysicalEntity
- State variables: Oxygen (kg), Status, Location
- Controlled by a human in-the-loop during simulation execution
- The Astronaut federate can instantiate multiple Astronaut objects

Institute of American Indian Arts (IAIA)created the SH & MRP 3D Models

Scouting Hopper (SH)



Mobile Resource Plant (MRP)



# Lunar Shuttle Cargo Lander and Subsystem Federates

Penn State Team

ZuQun Li

Michael Scott Bell

Vincent San Miguel

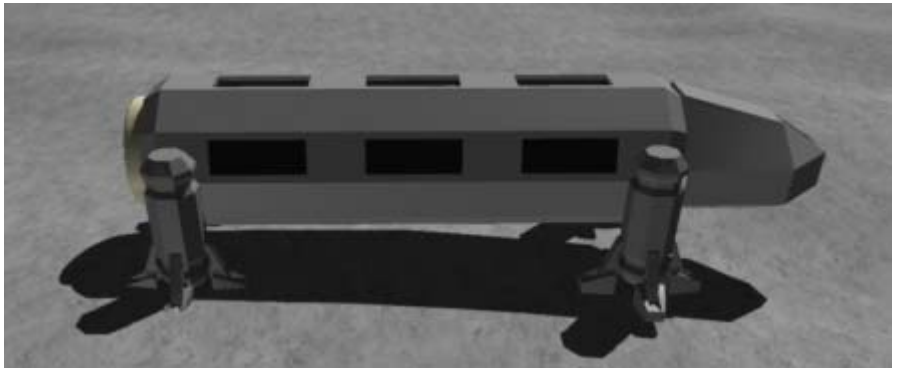
James H Bement

Implemented federates with JSC's TRICK HLA code library

- NASA Environment Federate - Reference frame data to compute coordinates for landing
- Astronaut - Repair Interaction &Take off permission
- Lunar Rover - Transfer Earth cargo to Rover, request fuel transfer and transfer Moon cargo to Lunar Shuttle
- L2Outpost - Subscribe to position
  - Provide Power, Thermal, and Communication subsystems models
- Communication Satellite
  - Use radio FOM to send messages

Subsystem Federates:

- Power
- Communications
- Thermal management



Lunar Shuttle Cargo Lander Graphics model by KSC team

# Lunar Rover Cargo Transfer Vehicle Federate

## *University of Nebraska Team*

- James M. Taylor - Team Leader
- Praneeth Talluri – Lead Software Engineer
- John Oerter – Lead Programmer
- Kyle Reestman – Programmer
- Nick Vanderveen – Programmer
- Mohammad Shafiullah – Hardware Support Engineer

Adopted the Lunar Rover federate from the Penn State team.

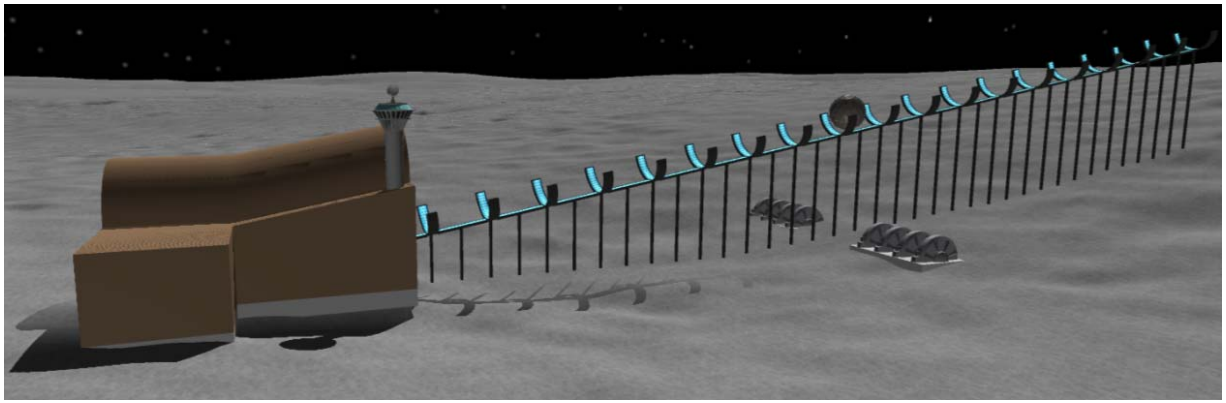
Developed with the JSC TRICK HLA code library

A variety of hardware, Linux operating system, and code library installation prohibited the deployment of the federate at the University of Nebraska.

The JSC team deployed the federate at the event.

Graphics model from the Sketchup Warehouse

# Lunar Mass Driver, Communication Satellites, and Integrated Visualization Federates

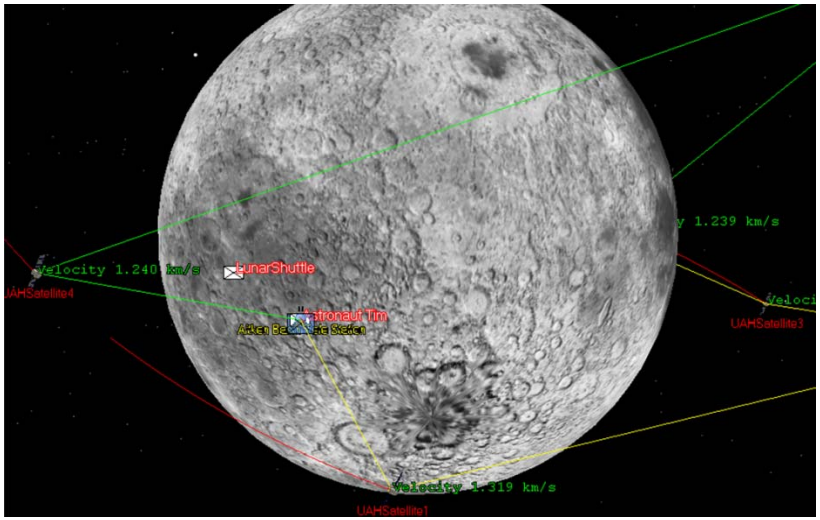


Lunar Mass Driver (LMD) 3D Graphics Model by KSC team

- Orbiter 2010 based LMD
- STK based communication satellite constellation (CSC)
- Java driver federate to test the CSC federate
- Matlab federate to stream telemetry to the KSC Unity 3D visualization application
- Matlab driver federate to test the telemetry streamer

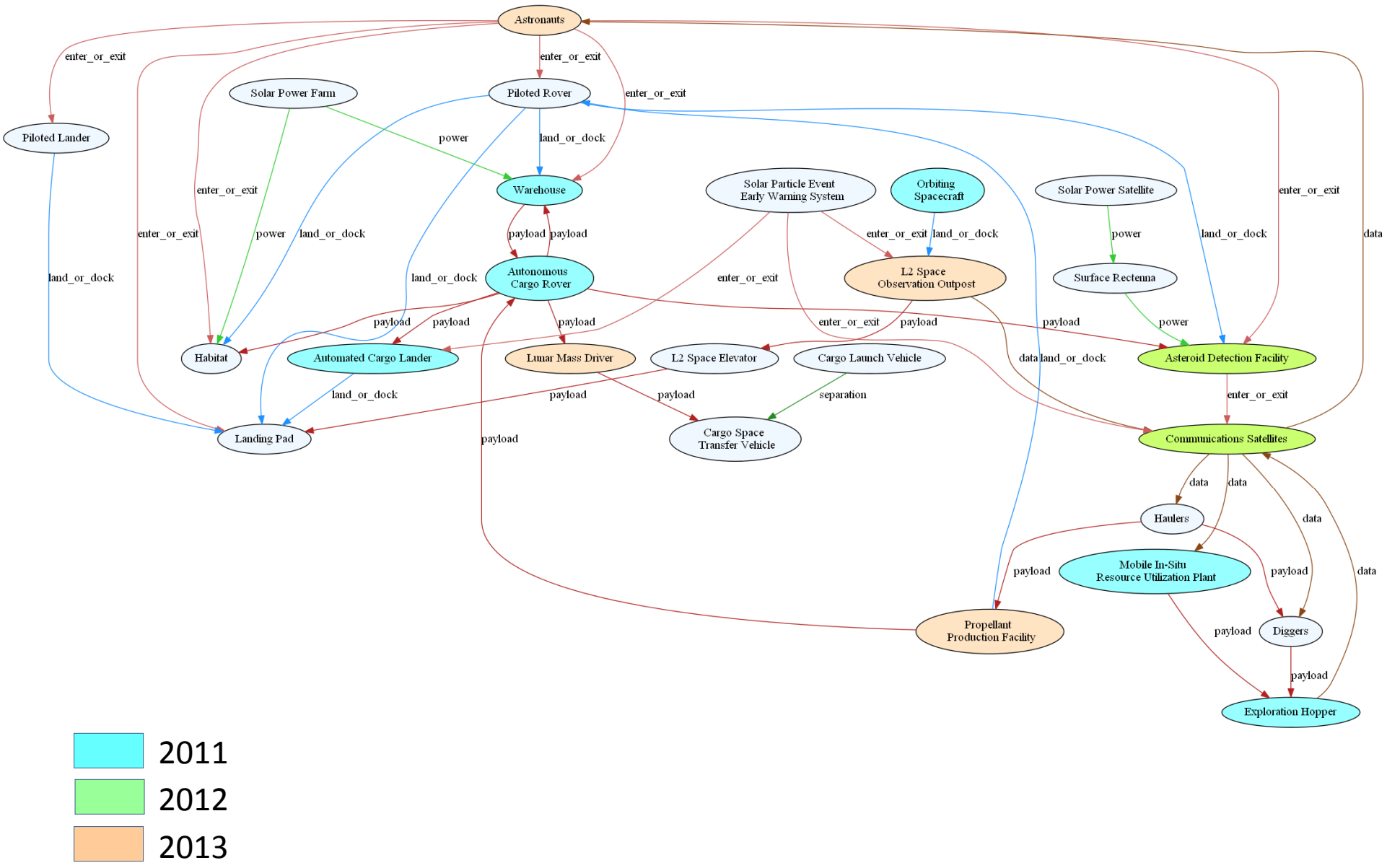
## *UAHuntsville Team Members*

- John Bland (HLA Interface to Orbiter 2010)
- Justin Brown (LMD Federate system engineer)
- Jonathan Patrick (Test and Integration)
- Melissa Redmond (Matlab Driver Federate)
- William Tucker (Team Leader)
- Bingyang Wei (System Tool Kit Federate)
- Tymaine Whitaker (Matlab & Unity 3D federate)




Screenshot from System Tool Kit (STK) Federate

# Populating a Lunar Settlement Architecture



# Conclusions

## Accomplishments 2013

- Refactored the Environment Federate as open source software based on the Java Astrodynamics Tool Kit
  - Recommended by Dennis Bulgatz from AMA
  - Implemented by Zack Crues at JSC
- Developed an HLA interface to Orbiter 2010
  - Recommended by Martin Tapp at CAE, inc., in Canada
  - Implemented by John Bland, UAHuntsville and Army
- Integrated The Unity Tool (TUT) developed by KSC with a data recording function
  - Recommended by Mike Conroy and Priscilla Elfrey KSC
  - Implemented by Tymaine Whitaker at UAHuntsville & SAIC
- Developed an HLA Interface for the free version of STK
  - Recommended by Bill Tucker at UAHuntsville
  - Implemented by Binyang Wei at UAHuntsville
- Effectively used VSee video conferencing during development, integration testing, and demonstration
  - Recommended by Mike Conroy

## Recommendations for 2014

- Define decision making processes that engage the professional societies.
- Specify space exploration scenarios with interactions among the systems.
- Establish a detailed schedule for deploying the development infrastructure.
- Before the demonstration, explain the scenario, FOMs, and federates.
- Acquire audio visual equipment to improve sound quality.
- Engage judges during the development process for insight to the teams' progress.
- Require teams to answer a design and process questionnaire to be used by judges.
- Develop demonstrations of transforming between coordinate systems.
- Develop a tutorial for time management.
- Provide example SEE federates for Matlab and C++.