Completed Project (2009 - 2015)

Distributed Visualization Project

Human Exploration And Operations Mission Directorate (HEOMD)

ABSTRACT

Distributed Visualization allows anyone, anywhere to see any simulation at any time. Development focuses on algorithms, software, data formats, data systems and processes to enable sharing simulation-based information across temporal and spatial boundaries without requiring stakeholders to possess highly-specialized and very expensive display systems. It also introduces abstraction between the native and shared data, which allows teams to share results without giving away proprietary or sensitive data. The initial implementation of this capability is the Distributed Observer Network (DON) version 3.1. DON 3.1 is available for public release in the NASA Software Store (https://software.nasa.gov/software/KSC-13775) and works with version 3.0 of the Model Process Control specification (an XML Simulation Data Representation and Communication Language) to display complex graphical information and associated Meta-Data.

ANTICIPATED BENEFITS

To NASA funded missions:

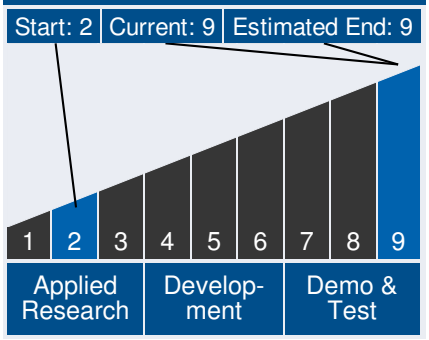
Achieving NASA's next era of exploration missions has an unprecedented dependence on successful collaboration between our Centers, commercial entities, academia, international partners and future generations. Enabling these teams to integrate and view their collective work promotes cooperation, fosters a deeper understanding of mission and programmatic goals, allows for issue identification and resolution at all phases of mission and system lifecycles and, as a result, increases the likelihood of multi-decadal mission success.

To NASA unfunded & planned missions:

NASA's long term exploration goals will span generations of scientists, engineers, technicians, managers, and astronauts. A

Table of Contents

Technology Maturity



Printed 2/11/2016

Distributed Visualization Project

Human Exploration And Operations Mission Directorate (HEOMD)

well architected distributed visualization capability will span these generations and enable the executors of tomorrow's missions to see and understand the intent of missions and systems developed by today's designers.

DETAILED DESCRIPTION

As NASA's teams grow increasingly diverse and even more dispersed, new means of sharing data and experiences among team members are required. Collaboration must occur across teams in different geographic locations, different time zones and, in the case of missions on the distant horizon, different generations. Each team brings a different gift to the table. They have different expertise and use different tools to meet their goals, yet they must all somehow come together to achieve a single vision. Distributed Visualization strives to unify teams and technologies by providing a common mechanism for sharing and integrating pertinent data. To accomplish this task, algorithms, software, data formats, data systems, and process are examined to identify and implement those which will best enable the sharing and integration of simulation-based information across temporal and spatial boundaries. To date, demonstrated work in Distributed Visualization has dealt with physics-based simulations and utilized a variety of graphics engines and toolkits. In addition to the application of these technologies, significant effort has been expended to define data elements, identify process commonality among simulation teams, establish interfaces, and evolve data standards. The result of the data standard work has been collected and published as the Model Process Control (MPC) Interface and documented for public use. This approach has resulted in a tool agnostic capability that relies on simple inputs and requires virtually no knowledge of how the data was generated, which allows collaboration without sharing source algorithms and system properties.

Realized Benefits

2 Publications

Management Team

Program Director:
- Douglas Craig

Program Executive:
- Michael Conroy

Program Manager:
- Michael Conroy

Project Managers:
- Tracey Kickbusch
- Rebecca Mazzone

Principal Investigators:
- Michael Conroy
- Rebecca Mazzone

Technology Areas

Simulation (TA 11.3)

Remote Data Access Framework (TA 11.4.1.8)

Continued on following page.

Distributed Visualization Project

Human Exploration And Operations Mission Directorate (HEOMD)

NASA validated these concepts, tools and methods with simulation results from Glenn, JPL, JSC, KSC and Langley, generated in everything from Dassault's Delmia to Google Sketchup to Microsoft Excel. Validation and testing continues with the NASA Simulation Exploration Experience (SEE). SEE is University level (Graduate and Under Graduate) STEM workforce initiative integrating simulations from international university team products into a common simulation and visualization environment. DON is the primary display tool for this effort.

Research areas for further enhancement include: use of data from other types of simulators (ex. Computational Fluid Dynamics, Discrete Event Simulation, Distributed Simulation), local storage vs. centralized storage, system latency and other network-induced challenges, and human-computer interaction. The initial implementation of this capability is the Distributed Observer Network (DON) version 3.1. DON 3.1 is available for public release in the NASA Software Store (https://software.nasa.gov/software/KSC-13775). Contact the Program Executive for additional information on DON, SEE or the MPC communication interface.

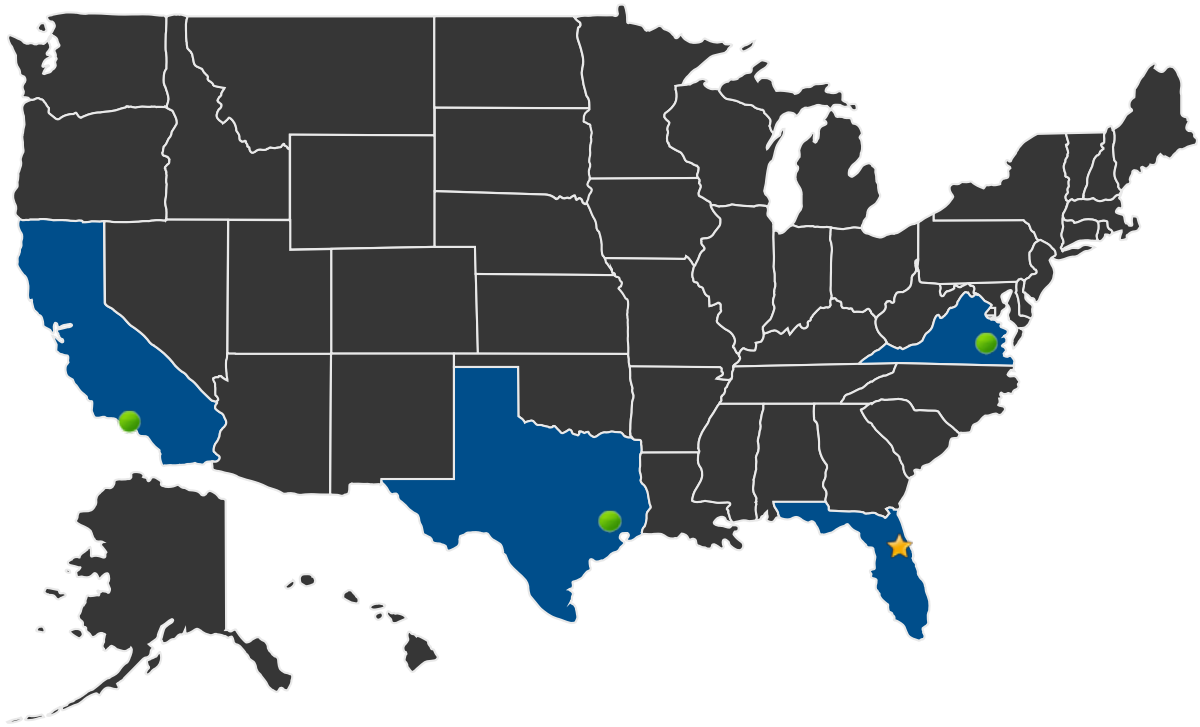
Technology Areas *(cont.)*

- Systems Engineering (TA 4.7)
- Decision-Making Tools (TA 13.3.8)

Distributed Visualization Project

Human Exploration And Operations Mission Directorate (HEOMD)

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Kennedy Space Center

Supporting Centers:

- Jet Propulsion Laboratory
- Johnson Space Center
- Langley Research Center

PROJECT LIBRARY

Publications

- Article in NASA IT Talk, Page 4

Continued on following page.

Publications *(cont.)*

- (http://www.nasa.gov/sites/default/files/files/IT_Talk_Apr2014.pdf)

- Technology Article in Kennedy Space Port Magazine, Page 14
  - (http://www.nasa.gov/sites/default/files/atoms/files/ksc_spm_dec2014.pdf)

DETAILS FOR TECHNOLOGY 1

Technology Title

Distributed Visualization

Technology Description

See Project Description

Capabilities Provided

Distributed Visualization enhances intra- and inter-team collaboration by eliminating boundaries imposed by time, space, data sensitivity, simulation system diversity, and technology obsolescence. These tools allow teams to communicate while protecting sensitive Intellectual Property. The data standards enable the use and re-use of analysis results, as well as inclusion of results into future simulations. The DON tool provides users with both a window into the simulation as well as the ability to pause and review the information (DVR function). Distributed Visualization aims to enhance intra- and inter-team collaboration by eliminating boundaries imposed by time, space, data sensitivity, simulation system diversity, and technology obsolescence.

Potential Applications

DON test and operational use supported Kennedy Design Visualization efforts for Ground Operations, the Simulation Exploration Experience outreach effort (test case in 2013, 2014, 2015, 2016) and Exploration Habitation studies (flight and ground operations).

DON supports multiple life cycle phases. Early life cycle projects (Concept Development) benefit from an easy way to share concept models and associated simulation data. Projects in middle of their lifecycel benefit from a rich visual environment able to display CAD quality data on standards workstations with internal and external partners. Projects in the operational phases of their lifecylce can use DON to integate wtih future systems, investigate alternatives, and share operational environments with partners in cases where sharing detailed design information is not possible (SBU, ITAR).

Distributed Visualization Project

Human Exploration And Operations Mission Directorate (HEOMD)

The DON requirements of Portability, Iintellictual Property Preservation, Ease of Use, Standard Interfaces and the Game based implementation make DON ideal for Outreach, STEM and STEAM activities.

Performance Metrics

Metric	Unit	Quantity
Polygons at 30 frames per second	each	20,000,000