



NASA 2023 Tech Showcase Spaceline[®] Overview

Sanford Selznick, John Kidd, Carl Hergenrother

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Who we are

Sanford Selznick

Chief Software Architect

Sanford Selznick has over 35 years of experience, a Master's in Computer Science, 11 years as a biomedical researcher, 24 years developing software for spaceflight, 23 years of profitable business experience, and 7 years as Science Data Processing Lead for the OSIRIS-REx asteroid sample-return mission. Sanford's experience also spans over developing the ground data system for components of the Mars Odyssey and Mars Phoenix Lander planetary exploration missions. He is currently Software Lead on the NASA Aspera mission.

Carl Hergenrother

Chief Scientist

As an observational astronomer, Carl has over 29 years of experience in the study of asteroids, comets and meteors for the Catalina Sky Survey, Minor Planet Center, other NASA funded programs, and citizen science organizations. In addition, Carl has over 18 years of experience on the OSIRIS-REx mission where he contributed to mission science, design, and observation planning. He is currently Operations Co-Lead on the NASA Aspera mission.

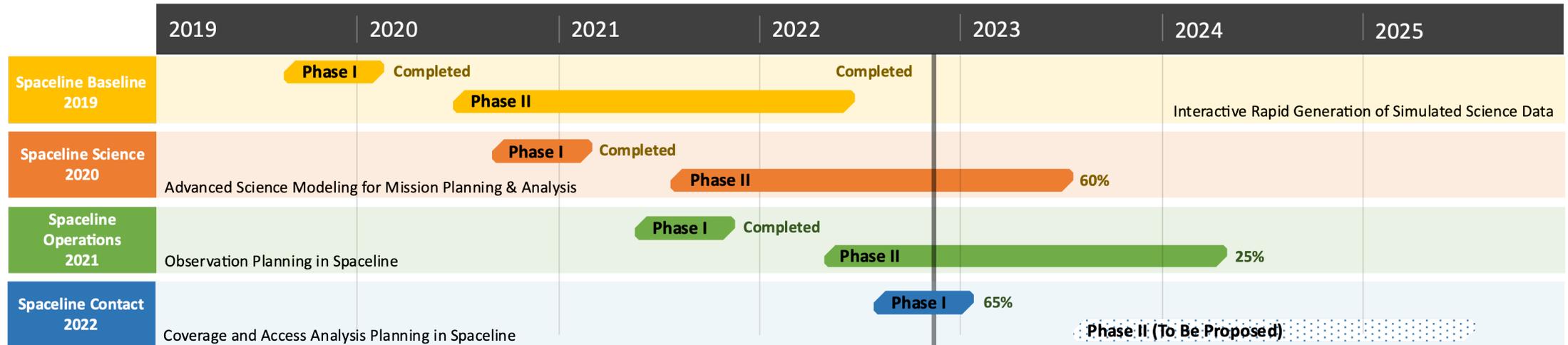
John Kidd

Chief Aerospace Engineer

As an aerospace systems engineer with 11 years of experience on the OSIRIS-REx Asteroid Sample Return Mission planning science observations with STK as the Senior Science Operations Planning Engineer, over 14 years of experience designing mission concepts with STK and GMAT, and 9 years experience developing software to support both of capacities. He is currently Operations Co-Lead on the NASA Aspera mission.



Our Product, Spaceline[®], NASA SBIR Funded!



Spaceline[®] Baseline –

- (1) SPICE kernel management
- (2) 3D interactive display of a scenario
- (3) simulation of science data for any onboard instrument for a given epoch (predicted future or reconstructed past)

Spaceline[®] Science –

- (1) additional planetary phenomenon (atmospheres, magnetic fields, and emission of particles and volatiles)
- (2) modeling of astronomical targets
- (3) persistent instrument footprints on planetary surfaces and the celestial sphere

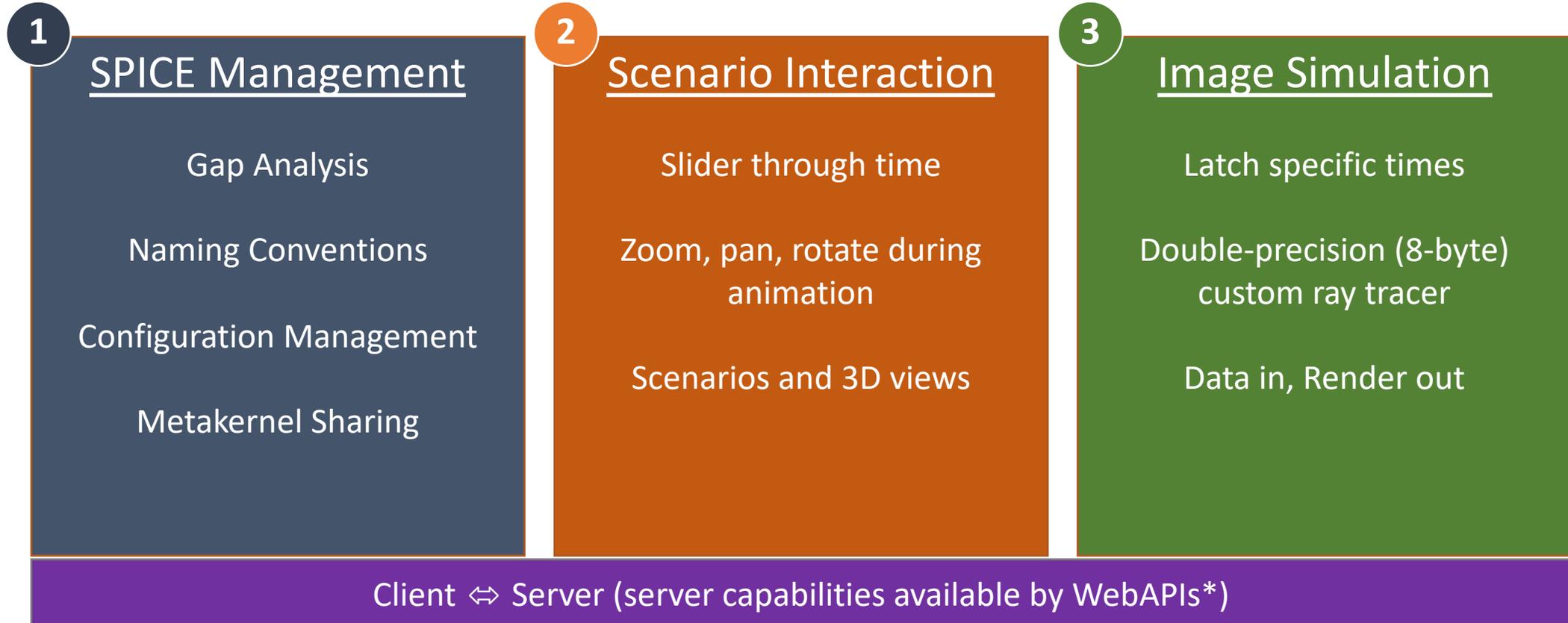
Spaceline[®] Operations –

- (1) infrastructure to define custom targets
- (2) ability to create an integrated attitude profile for an observation plan that slews between targets
- (3) ability to export and share custom targets and attitude profiles for communication with and analysis in external tools and processes

Spaceline[®] Coverage –

- (1) ability to calculate coverage of planetary bodies
- (2) ability to calculate coverage of regions on celestial sphere
- (3) Provide a tool to analyze line-of-sight between objects supporting the design of complex mission plans requiring data relays or shared resources between assets

The core of Spaceline[®] Today



*WebAPIs, like libraries, will allow users to integrate Spaceline[®] capability right into their own applications.

Plotting and Reporting with SPICE Kernels

Report Setup

CALCULATIONS REPORT TEMPLATES BUILD CHARTS RUN CHART OR REPORT

First select a SPICE function below

Spice function

Return the state (position and velocity) of a target body relative to an observing body, optionally corrected for light time (planetary aberration) and stellar aberration.

Next fill in arguments to spkezc(...) below

targ (ConstSpiceCharPtr)

et (SpiceDouble)

ref (ConstSpiceCharPtr)

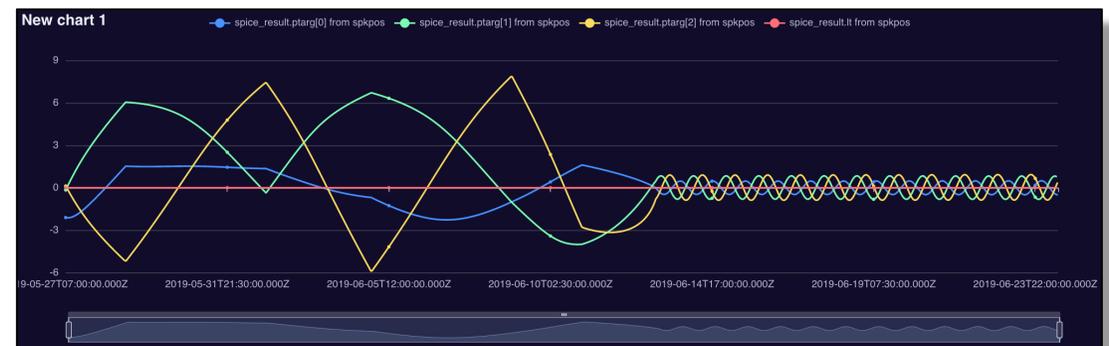
abcorr (ConstSpiceCharPtr)

obs (ConstSpiceCharPtr)

[EXECUTE WITH VMK ID 3](#)

CANCEL

- With integrated kernels, it's easy to use SPICE.
- Execute SPICE queries with buttons
- Make reports & charts



Spaceline[®] is Fully Scriptable

- Leverage all of Spaceline's features from your own scripts.
 - Python, Java, Perl, IDL, Matlab, and more
 - Perform automated analysis.
 - Leveraging our capabilities.
- Each Spaceline[®] is driven by AWS Lambda with 1000 cores available
- Postgres GIS database for spatial queries
- Extremely secure, https, VPNs, ITAR Capable, etc.

Kernel Management

- Uploads
- Kernel searches and filtering
- VMK building with ordering
- Gap displays
- Kernel details

The screenshot displays a list of kernel entries in a table. Each entry includes an ID, version, name, and timestamp. Below the table, three detailed views are shown for kernels 34, 38, and 26. Each detail view contains the following information:

- Author:** (empty)
- File size:** 48.42 MB [50,770,944 bytes] for kernel 34; 48.66 MB [51,024,896 bytes] for kernel 38; 49.41 MB [51,810,304 bytes] for kernel 26.
- Type:** CkFile
- Hash:** dc6be3488938355082671d2fb8dee8b1 for kernel 34; 691503cf23b1f893a2e668bae11fb048 for kernel 38; 2a26ea6f4b8541415d35ef787dbef69f9 for kernel 26.
- Navigation:** COVERAGE (active), METADATA, COMMENTS
- Coverage Graph:** A horizontal bar chart showing coverage for 'unnamed [NAIF -64000]: 0 gaps'. The bars for kernels 34 and 38 are mostly green, while the bar for kernel 26 has a small green segment on the left.

Immersive Scenario Interaction

The screenshot displays the 'SBIR Review Spaceline' web application. The interface is divided into a control panel on the left and a 3D visualization on the right. The control panel includes a 'HIDE CONTENTS' section with a dropdown menu set to 'BENNU', start and end date fields (2019-05-07T17:00:00.000Z and 2019-05-11T17:00:00.000Z), a timestep field (60), and a list of objects to render. The 'SPACE POINTS' section is expanded, showing 'ORX' objects with checkboxes for 'ORX_OCAMS_POLYCAM', 'ORX_OCAMS_SAMCAM', 'ORX_NAVCAM2', 'ORX_NAVCAM1', and 'ORX_OCAMS_MAPCAM', all of which are checked. Below this, 'BENNU' is also checked, while 'EARTH', 'MARS', and 'MERCURY' are unchecked. A large orange bracket on the right side of the control panel encompasses the 'ORX' and 'BENNU' sections, with the text 'All Options Harvested from SPICE' next to it. The 3D visualization shows a dark space scene with a grey, textured sphere representing Asteroid Bennu. Two camera fields of view are shown as semi-transparent grey planes originating from a point on the left, with lines indicating their orientation. The Earth is visible in the background. A timeline at the bottom of the visualization shows the current time as 2019-05-08T06:57:00.000Z. The footer of the application reads 'Spaceline® © Ascending Node Technologies, LLC, 2022' and 'v 0.4.43'.

SBIR Review Spaceline

HOME KERNELS COMPOSITION RENDERERS

HIDE CONTENTS [SAVE ALL](#)

Choose a central body
BENNU

Start date
2019-05-07T17:00:00.000Z

End date
2019-05-11T17:00:00.000Z

Timestep (seconds)
60

1.7e+4 data points will be generated.

Check objects below to render in the scene. They'll be rendered if their data are available for the selected timespan.

- SPACE POINTS
 - ORX
 - ORX_OCAMS_POLYCAM
 - ORX_OCAMS_SAMCAM
 - ORX_NAVCAM2
 - ORX_NAVCAM1
 - ORX_OCAMS_MAPCAM
 - BENNU
 - EARTH
 - MARS
 - MERCURY

All Options Harvested from SPICE

Asteroid Bennu in the fields of view of two cameras

2019-05-08T06:57:00.000Z

Spaceline® © Ascending Node Technologies, LLC, 2022 v 0.4.43

Integrated double precision ray tracing



OSIRIS-REx MapCam image of asteroid Bennu taken on
2019-May-28T12:58:25.292Z



Spaceline® Render

Intuitive User Experience

The screenshot displays a user interface for kernel management. On the left, a sidebar contains navigation links: APPEARANCE, FILE TREATMENTS, SURFACE IMAGES, STARS, APIS, and TAGS. The 'APPEARANCE' section is expanded, showing a 'Dark Mode' toggle with 'Off' selected. The main content area lists two kernel entries. The first entry (ID 44) has a file size of 48.91 MB and a hash of e571e74abfde20e1acebe4551c0f97a4. The second entry (ID 33) has a file size of 48.53 MB and a hash of 8a6e929826dd45d1552cf0563caaf3c. Both entries have tabs for 'COVERAGE', 'METADATA', and 'COMMENTS'. The 'COVERAGE' tab is active for both, showing a progress bar for 'unnamed [NAIF -64000]: 0 gaps'. On the right, a 'Kernel Search' panel is visible, listing search criteria such as CK COVERAGE, SPK COVERAGE, KERNEL TYPE, KERNEL ID, KERNEL NAME, UPLOAD DATE, and CUSTOM SEARCH. At the bottom, a navigation bar includes 'UPLOAD KERNELS', 'FIND KERNELS', and 'FIND METAKERNELS'. The ANT logo is located in the bottom right corner.

Current Customers

- Lots of proposal support
 - Proposal solicitations:
 - Astrophysics
 - Heliophysics
 - And more!
 - ConOps feasibility analysis
 - Target scheduling
 - Coverage analysis
 - Ground Data System
 - Software development management
 - Student mentorship programs
- Aspera mission support
 - Astrophysics Pioneers program
 - ConOps support
 - Mission scheduling
 - Spacecraft constraint validation
 - Ground Data System
 - Centered around Spaceline®
 - Leading student development team
 - Assisting data pipeline development
 - Spacecraft & Instrument commanding software
 - Integrated spacecraft test suite