

Navigation and Ancillary Information Facility

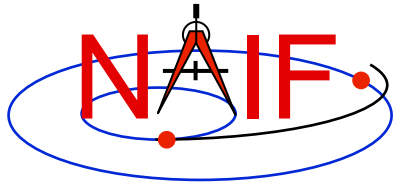
NAIF Report

Covers Node and SPICE Development

September 29, 2015

Chuck Acton

Boris Semenov



FY15 NAIF Staff

Navigation and Ancillary Information Facility



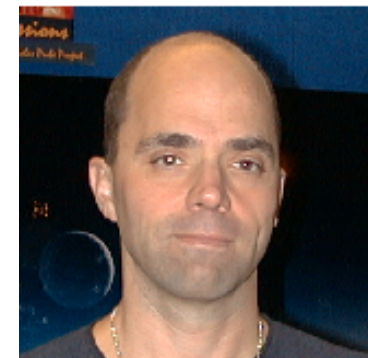
Chuck Acton



Nat Bachman



Boris Semenov



Ed Wright



**Mark Rose
(WebGeocalc
part time)**



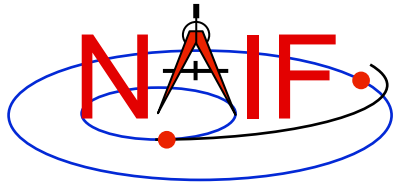
**Eric Ferguson
(Cosmographia
part time)**



**Michelle Park
(Cosmographia
summer student)**



**Farhan Alam
(Cosmographia
summer student)**



FY16 NAIF Staff

Navigation and Ancillary Information Facility



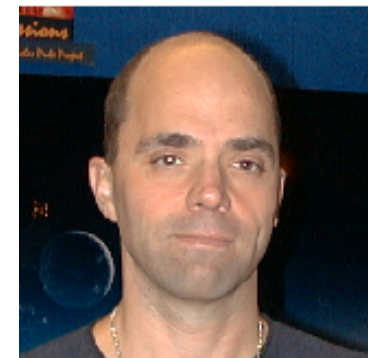
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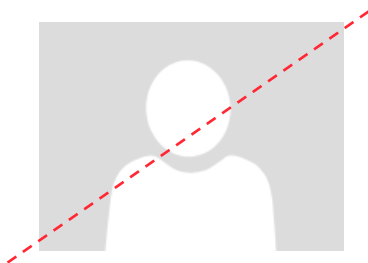
Boris Semenov



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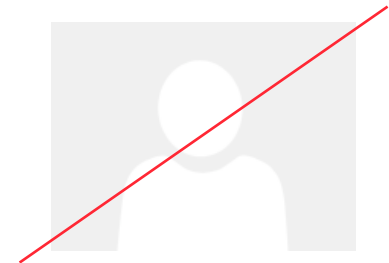
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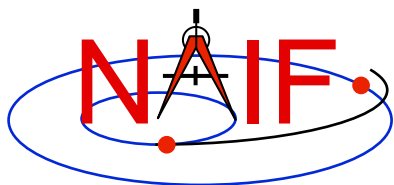
Eric Ferguson
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consultant only)



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summer student)



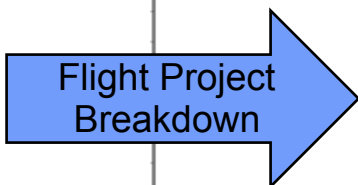
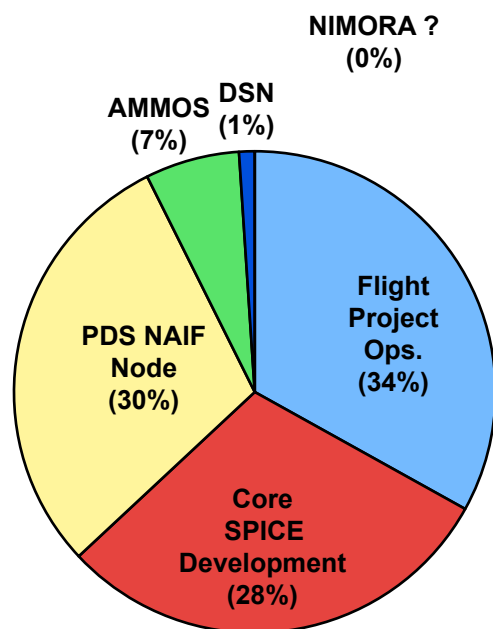
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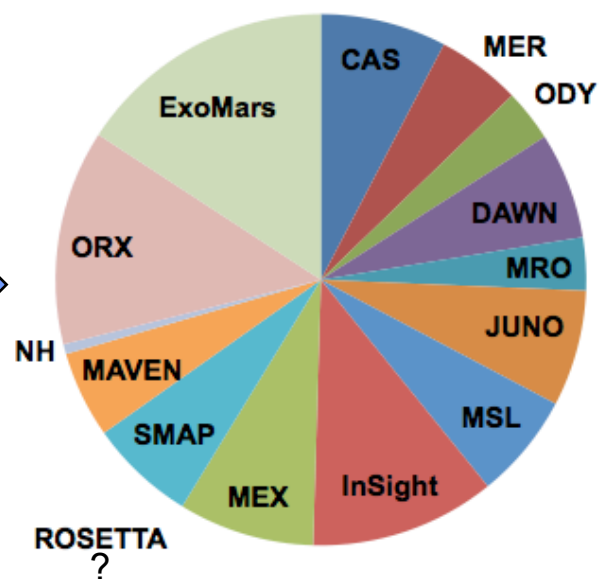
NAIF Group Funding

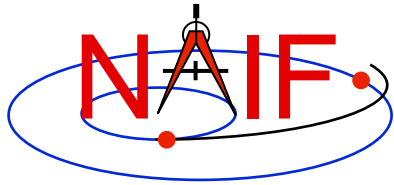
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NAIF FY16 Funding



FY16 Flight Project Contributions

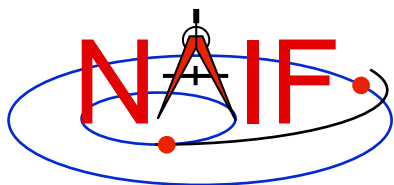




What's New?

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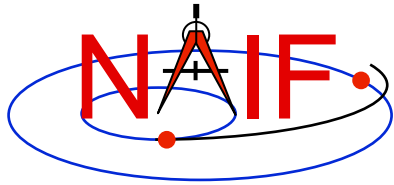
- **No “major new node initiatives”**
 - **SPICE is SPICE is SPICE is SPICE is SPICE**



Archive Status - 1

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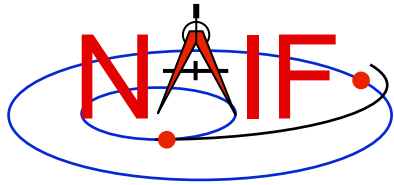
Task Title	Budget				Schedule				Technical				External			
	FY2015				FY2015				FY2015				FY2015			
	May	Jun	Jul	Aug	May	Jun	Jul	Aug	May	Jun	Jul	Aug	May	Jun	Jul	Aug
NASA Active Roll-up	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Mars Odyssey	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Cassini	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
MER	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
MRO	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Messenger	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
New Horizons	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
MSL	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
LRO	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
DAWN	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
JUNO	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
MAVEN	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
OSIRIS REX	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
InSight	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G



Planned Archive Work

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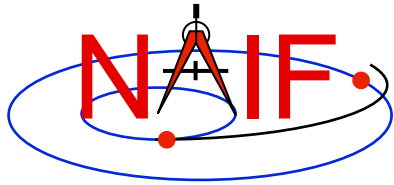
- **Finalize PDS4 archive process and update our SPICE Archiving User's Guide accordingly.**
- **Convert staged LADEE SPICE data to PDS4 compliance.**
- **Set up automated update of NAIF Node's PDS3-proxy and PDS4 product registries.**
- **Validate and ingest final MESSENGER archive.**
- **Continue validation and ingest of archive increments from still flying missions.**
- **Restart validation and ingestion of three ESA mission archives, if/when ESA restarts archive production.**



Planned NAIF/SPICE Work - 1

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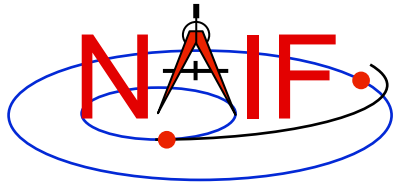
- **Release the programmatic interface to WebGeocalc (October).**
 - Follow up with addition of more computational capability.
- **Release a new version of the Cosmographia visualization program, including on-line UG and video tutorials (October).**
- **Addition of many new dynamic reference frames, with allied documentation (December).**
- **Prepare and present Performance Review material (January).**
- **Finish the tessellated plate model portion of the Digital Shape Kernel and release this in the next (N66) Toolkit (~January).**
- **More toolkit performance improvements (N66 Toolkit release).**
- **Possible change to a new spacecraft numbering schema.**
 - In the CubeSat era, the DSN will be recycling IDs more-and-more.
 - (NAIF will first try to get the DSN to expand beyond the 0 – 255 range.)



Planned NAIF/SPICE Work - 2

Navigation and Ancillary Information Facility

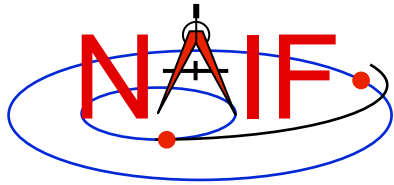
- **Conduct a beginner's class near Pasadena (~April).**
- **Finish the digital elevation model portion of the Digital Shape Kernel.**
 - Maybe official release a year from now?
 - Then ingest available data for Mars, Moon, Mercury, other?
- **Begin preparing an advanced user's class (for FY17).**
- **Finish Java Native Interface Toolkit (when?)**
- **Implement Python Toolkit (when?)**
- **Assess means to produce thread-safe and object-oriented Toolkits (Sep 2016).**
- **Work with the new IAU Fundamental Standards Commission to:**
 - speed up access to standards,
 - document standards,
 - educate the community about standards.
- **Possibly work with the new IAU Ephemeris Commission to adopt SPK as its standard for satellites, comets and asteroids (as has now been done for planets).**



Interfaces to SPICE Data

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- **Downloading SPICE data:**
 - Use the NAIF node download page
 - » http://naif.jpl.nasa.gov/naif/data_archived.html
 - » This includes a dataset sub-setter capability
 - For very large archives, this reduces the volume of data transferred if only data for a limited time range is needed.
 - Automatically constructs a new meta-kernel for this subset.
- **Using SPICE data:**
 - Toolkit APIs (subroutines) for 44 different computing environments allow users to write unique geometry computation programs.
 - WebGeocalc provides geometry calculations using archived SPICE data without having to write a SPICE-based program.
 - Cosmographia provides a visual representation of archived SPICE data.



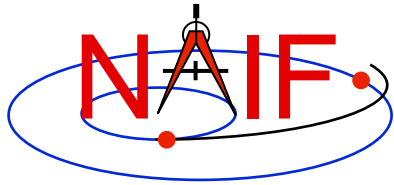
Experience with Archiving Plans

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- **NAIF’s “Support” webpage contains the following statement:**

For anyone who will be preparing an official SPICE archive for one of the NASA Planetary Science Division's flight projects, NAIF can provide a [SPICE Archive Guide](#) along with tools and examples. As the Navigation Node of the PDS, NAIF will conduct a review of the proposed archive process, and will review incremental data set submittals from the flight project. Once each data set increment has passed review, NAIF will ingest it and make it available to the worldwide planetary science community from the NAIF Node of the Planetary Data System. **IMPORTANT NOTE:** this is only an archive preparation service; it does not provide for instruction on the production, validation or use of SPICE kernels.

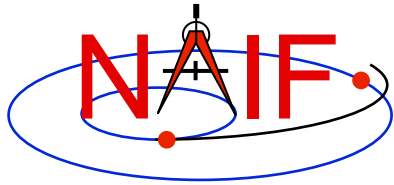
- **NAIF hasn’t specific advice/statement for Roses submitters, but could add Roses to the above.**



Potential Issues over 24 Months

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- **Legitimate requests for help take a lot of time.**
 - Any way to reduce these?
- **If/how to deal with ever-growing number of requests for help from non-paying entities.**
 - U.S. and foreign flight projects
 - Assorted other NASA-based and external entities, including DoD
 - Students from everywhere asking about everything
- **No sub-node issues.**
- **No succession plans.**



SPICE Users

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<i>Data Restorations</i>	<i>Selected Past Users</i>	<i>Current/Pending Users</i>	<i>Possible Future Users</i>
Apollo 15, 16 [L]	Magellan [L]	Cassini Orbiter	NASA Discovery Program
Mariner 2 [L]	Clementine (NRL)	Mars Odyssey	NASA New Frontiers Program
Mariner 9 [L]	Mars 96 (RSA) [F]	Mars Exploration Rover	
Mariner 10 [L]	Mars Pathfinder	Mars Reconnaissance Orbiter	
Viking Orbiters [L]	NEAR	DAWN	ExoMars 2018 (ESA, RSA)
Viking Landers [L]	Deep Space 1	Mars Science Lab	Luna-Glob (RSA)
Pioneer 10/11/12 [L]	Galileo	Juno	NISAR (NASA and ISRO)
Haley armada [L]	Genesis	MAVEN	
Phobos 2 [L] (RSA)	Deep Impact	SMAP (Earth Science)	
Ulysses [L]	Huygens Probe (ESA) [L]	OSIRIS REx	<i>Examples of Users not Requesting NAIF Help</i>
Voyagers [L]	Stardust/NExT	InSight	Solar Probe Plus
Lunar Orbiter [L]	Mars Global Surveyor	Mars 2020	EUMETSAT GEO satellites [L]
Helios 1,2 [L]	Phoenix	Europa Clipper	MOM (ISRO)
	EPOXI		BepiColombo (ESA, JAXA)
	GRAIL	Lunar Reconnaissance Orbiter	JUICE (ESA)
	Messenger	New Horizons	Solar Orbiter (ESA)
	Phobos Sample Return (RSA) [F]	Mars Express (ESA)	Chang'e 3 (CNSA)
	Venus Express (ESA)	Rosetta (ESA)	Van Allen Probes [L]
	Chandrayaan-1 (ISRO)	ExoMars 2016 (ESA, RSA)	STEREO [L]
	Hayabusa (JAXA)	Akatsuki (JAXA)	Spitzer Space Telescope [L]
[L] = limited use	Kaguya (JAXA)	Hayabusa-2 (JAXA)	Kepler [L]
[S] = special services	LADEE	Space Launch Systems (HEOMD)	Hubble Space Telescope [S][L]
[F] = mission failed	ISO [S] (ESA)		Radioastron (RSA) [L]
	CONTOUR [F]	Planetary Data System	IBEX [L]
	Space VLBI [L] (multinational)	JPL Solar System Dynamics Group	James Webb Space Telescope [S][L]
Last updated: 9/24/15	Smart-1 (ESA)	NASA Deep Space Network [S]	Proba-3 (ESA)

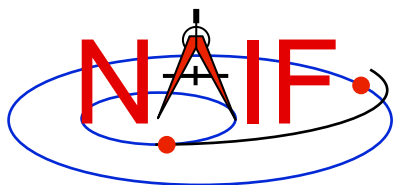
■ NAIF has or had project-supplied funding to support mission operations, consultation for flight team members, and SPICE data archive preparation. NAIF also has PDS funding to help scientists and students with using SPICE data that have been officially archived at the NAIF Node of the PDS.

■ NAIF has or had NASA funding to support a foreign partner in SPICE deployment and archive review, and to consult with flight team SPICE users.

■ NAIF has token funding to consult with kernel producers at APL. APL provides support to science teams.

■ NAIF has or had modest PDS-supplied funding to consult on assembly of a SPICE archive.

■ NAIF has PDS funding to help NASA funded scientists using SPICE data that have been officially archived at the NAIF Node of the PDS.



Miscellany

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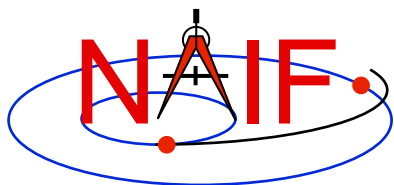
- **NAIF currently has 504 people signed up to the “spice_announce” *Mailman* list.**
 - Certainly some are not bona fide SPICE users.
 - We know there are many SPICE users not signed up.

- **If anyone wishes to see a demo of:**
 - **the latest *Cosmographia***
 - or
 - **WebGeocalc**

during a break, see Boris (both) or Mark (only WGC).

“It’s just wonderful stuff!”

-- Attributed to H. L. Mencken



Philae Landing

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