

OPUS 3.0: The New and Improved Outer Planets Unified Search Tool – 10th Anniversary Edition. R. S. French¹, D. J. Stopp¹, Y.J Chang¹, M. R. Showalter¹, M. K. Gordon¹, M. S. Tiscareno¹, M. W. Evans¹. ¹SETI Institute, 189 Bernardo Ave Suite 200, Mountain View, CA 94043, rfrench@seti.org

Introduction: Outer Planets Unified Search (OPUS) is a comprehensive search tool provided by the Ring-Moon Systems node of NASA’s Planetary Data System (PDS). First released to the public ten years ago, OPUS has evolved to handle modern web technologies, massive new data sets, more sophisticated searches, and easier browsing and downloading of data.

OPUS currently hosts 1.5 million images and spectra from Cassini, Voyager 1 and 2, Galileo, New Horizons, and the Hubble Space Telescope. In addition to an intuitive web-based user interface that allows cross-mission and cross-instrument searches of the metadata provided by each instrument team, OPUS adds searchable metadata describing surface geometry and lighting of all planets and satellites in the field of view as well as ring plane geometry and lighting where applicable.

OPUS 3.0: We have recently released OPUS 3.0, a major rework of the OPUS software. While providing the same basic capabilities as previous versions of OPUS, this new version includes:

- A new help system, including:
 - A new “About” box giving the details of what OPUS can do and what missions and instruments are supported.
 - A “Frequently Asked Questions” section giving details on how to perform more complicated searches.
 - A “Recent Announcements” section detailing the on-going improvements being made.
 - Improved “tooltips” for search terms and downloadable product types.
- A wide variety of acceptable formats for date and time, from the standard ISO 8601 format (“1976-07-04T14:00:00”) to more free-form formats (“4 July 1976 14:00”).
- Real-time validation of all input fields, especially useful for date/time and spacecraft clock count, which can have non-obvious formats.
- Real-time lists of string search results as partial strings are typed (similar to that provided by Google search).
- Default measurement units and specific precision on all numerical values.
- Support for downloading previous versions of data products.

- The ability to add thousands of observations to your “cart”. If your cart is too large to download directly, you can instead download a list of URLs that can be retrieved using the **wget** command-line utility.

In addition, the internals of OPUS have undergone major upgrades resulting in improvements in reliability, testability, performance, and future expandability, and we have deployed a new high-performance server to support OPUS for many years to come.

Navigated Cassini Images: As reported previously [1], the Ring-Moon Systems node is in the process of completing a re-navigation of all Cassini ISS images. Once finished later this year, approximately 75% of these images will be navigated to single-pixel accuracy. We will then be able to produce more than 90 backplanes that specify, for each pixel of each image, values such as:

- Identification of the frontmost body occupying the pixel.
- Latitude and longitude of the frontmost body, or radius and inertial longitude in the ring plane.
- Incidence, emission, and phase angles at the surface of the frontmost body or ring plane.
- Distance to the frontmost body and its pixel resolution.

These backplanes will be available for download, eliminating the need for end users to write complicated software to calculate these values themselves. At the same time, we will provide user-friendly preview images that identify each body and ring feature in the field of view. These preview images will be integrated into OPUS so that one no longer needs to ask “What moon is that?” when scanning through images.

Other Future Plans: OPUS 3.0 provides a solid foundation for both near- and long-term feature development. Some of the improvements currently planned include:

- The addition of ring occultation profiles from the Cassini VIMS, UVIS, and RSS instruments.
- The addition of composite products, such as ring profiles, image mosaics, and multi-color sequences.
- Metadata histograms to allow easier narrowing of search results.
- Integration of PDS4 data products.

References: [1] French, R. S. et al. (2017) Planetary Data Workshop.