Combining Open-Source Packages for Planetary Exploration

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The science planning of the ESA Rosetta mission has presented challenges which were addressed with combining various open-source software packages, such as the SPICE toolkit, the Python language and the Web graphics library three.js. The challenge was to compute certain parameters from a pool of trajectories and (possible) attitudes to describe the behaviour of the spacecraft. To be able to do this declaratively and efficiently, a C library was implemented that allows to interface the SPICE toolkit for geometrical computations from the Python language and process as much data as possible during one subroutine call. To minimise the lines of code one has to write special care was taken to ensure that the bindings were idiomatic and thus integrate well into the Python language and ecosystem. When done well, this very much simplifies the structure of the code and facilitates the testing for correctness by automatic test suites and visual inspections. For rapid visualisation and confirmation of correctness of results, the geometries were visualised with the three.js library, a popular Javascript library for displaying three-dimensional graphics in a Web browser. Programmatically, this was achieved by generating data files from SPICE sources that were included into templated HTML and displayed by a browser, thus made easily accessible to interested parties at large. As feedback came and new ideas were to be explored, the authors benefited greatly from the design of the Python-to-SPICE library which allowed the expression of algorithms to be concise and easier to communicate.

In summary, by combining several well-established open-source tools, we were able to put together a flexible computation and visualisation environment that helped communicate and build confidence in planning ideas.