

GUI RETRIEVAL OF FOVS IN HARMONICS FOR 2018 RENDEZVOUS OF HAYABUSA2

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Introduction: Hayabusa2 is arriving at the asteroid 162173 Ryugu for sample return in this summer. This study has developed a visualization tool based on the SPICE toolkit [1] for FOVs of scientific instruments and geometry between the spacecraft and the target asteroid in Hayabusa/Hayabusa2 missions. This tool had been used for making mission plans during the rendezvous of the original Hayabusa in 2005. This tool has been named as HARMONICS: HAYabusa Remote MONItoring and Commanding System [2, 3]. The HARMONICS can change FOVs with positions and attitudes of the spacecraft from imported SPICE kernels in order to consider observation scenarios, although Cosmographia[4] has been known as just a similar visualization tool.

The HARMONICS had been updated with modern frameworks (Figure 1) [5, 6, 7]. Then this study increases the number of available instruments, switching or simultaneous displaying FOVs for instruments. Previous HARMONICS handled only a telescopic camera (AMICA) on Hayabusa. This study adds a new GUI retrieval of FOVs (partly matching footprints on the shape model) where an instrument observed or not.

Uses and New goals of HARMONICS: One is planning a mission scenarios for deviding observation timing. Another is supporting adata analysis/interpretation by visualization of FOVs, instrumnets pointings, and 3D-geometry of the spacecraft with asteroid.

This study enhances HAMRONICS for the two uses. New goals in implementations are displaying coverage of previous observations based on GUI retrieval of FOVs, and displaying/switching FOVs of instruments.

System design: The development environment of HARMONICS is shown Table 1. A database of HARMONICS has been established by MySQL, but MySQL needs to register accounts. This system is not for beginners. The database language has been replaced from MySQL to SQLite3.

This study has implemented GUI retrieval of FOVs to HARMONICS. This function uses the database. The database links each image with polygon IDs, and brings capability of achievements of observations by GUI on a shape model. Users select polygons on GUI of the shape model. HARMONICS searches observed images with selected polygon IDs from the database.

This study has refined module of HARMONICS. The module of HARMONICS is constructed based on Figure 2. 3D model rendering system of HARMONICS has been developed by OpenGL. This study has refined

this rendering system for picking up polygon IDs. Observed images are brought by using polygon IDs from the database.

Differences from previous HARMONICS: The database is established by importing SPICE kernel. HARMONICS searches polygon IDs of observed images from imported SPICE kernel. The database is established for each observed mission. Users can name each observed mission. The database store information of a name of observation, scientific instruments, observed images, polygons, polygon IDs.

Figure 3 is an appearance of GUI retrieval of FOVs. Information about the database is shown in the blue area. A Shape model is rotated with the mouse. A user can select polygons with “Select region” button. In green circle, Selected polygons are visualized by coloring polygons. The result of searching is file names in the purple area. The red area in the shape model is coverage areas. Coverages of observation are visualized by selecting listed images.

Demonstration: HARMONICS will be demonstrated at this 49th LPSC in 2018. Anyone can download and test the latest HARMONICS via “arcspace.jp”

Future works: Current HARMONICS has two topics as future works. One is texture mapping of images on shape models, in order to check observed data directly. Another is verification with cross-platforms such as Windows and LINUX. Current HARMONICS has been verified with only MacOS.

Acknowledgements: I’m pleased to acknowledge Ms. Nemoto as the original developer of HARMONICS and Mr. Ueno as the main developer of the previous version. The main part of the current HARMONICS was supported by JSPS KAKENHI Grant Number JP17K05639 and FY2017 Coordination Funds for Promoting AeroSpace Utilizaiton MEXT, Japan.

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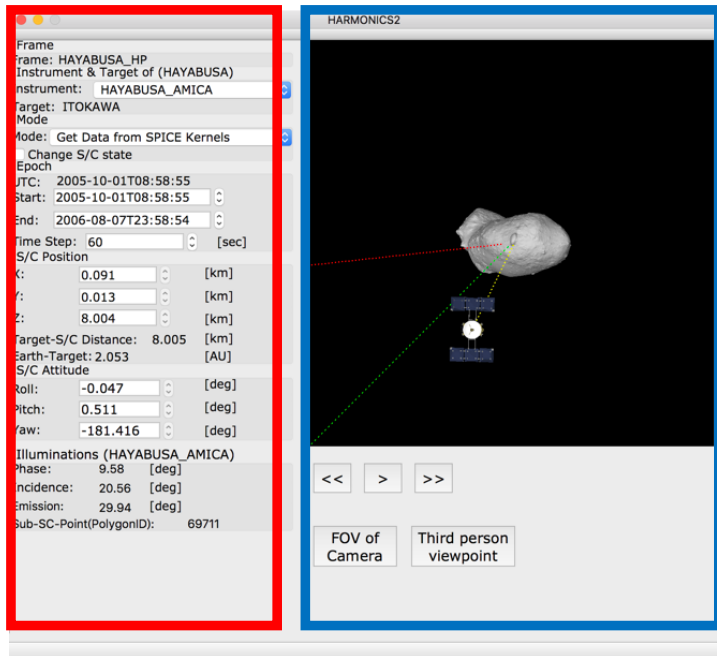


Figure 1. HARMONICS

In left, showing data of scientific instruments, simulation time and position/attitude of the spacecraft. In right, a result of simulation form imported SPICE kernel.

Table 1. Development environment

	Name	Version
IDE	QtCreator	4.3.0
Framework	OpenGL	4.5
	OpenCL	2.2
	SPICE toolkit	N0066
	Cfitsio	3.4
	CCfits	2.4
	OpenCV	3.2.0
Language	Qt	5.8.0
	C++	
	SQLite3	3.21.0

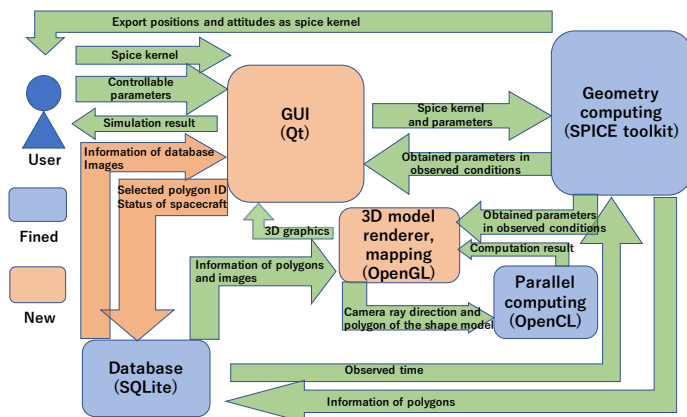


Figure 2. The Module of HARMONICS

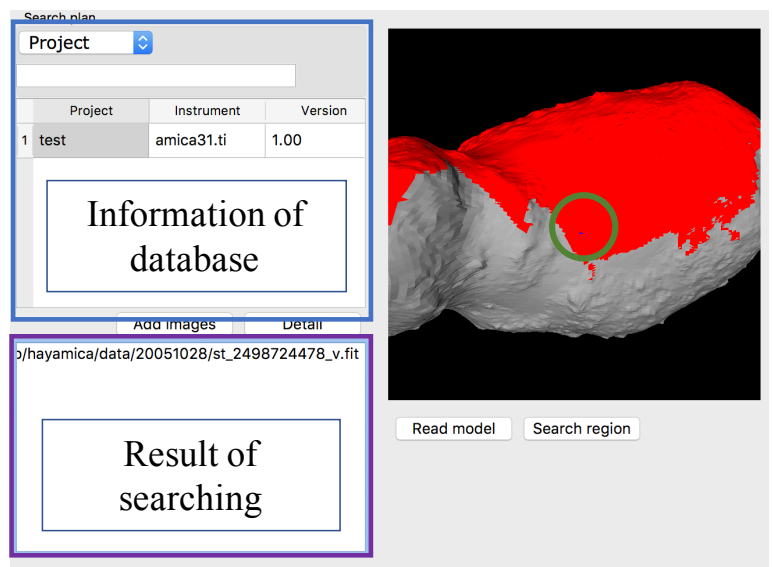


Figure 3. The interface for retrieval of FOVs