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# はやぶさ２搭載分離カメラ（DCAM3）撮像対象物の輝度予測と撮像戦略
# Imaging strategy of DCAM3 equipped on Hayabusa2 based on radiance prediction of imaging objects

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Hayabusa2, the next Japanese asteroid explorer successfully launched at 13:22:04 on December 3, 2014 from the Tanegashima Space Center toward a C-type asteroid 1999JU3, brings a deployable camera called DCAM3. Separated from the mother ship Hayabusa2, DCAM3 will observe an artificial impact on the surface of 1999JU3 performed using Small Carry-on Impactor (SCI) [1, 2]. DCAM3 has two camera systems: a monitoring camera (DCAM3-A) and a scientific camera (DCAM3-D). DCAM3-D possesses a high resolution (<1 m/pix at a distance of 1km) and wide angle (74 degrees) optical system for the following two objectives. First objective of DCAM3-D is to image an impact crater produced by SCI and fragments (i.e., ejecta) thrown out of the crater. Second objective is to image Small Carry-on Impactor (SCI) before explosion, which will float several hundred m above the surface of 1999JU3 and $\simeq$1 km away from DCAM3. Imaging SCI enables us to estimate the location of SCI explosion and the impact direction that is an important parameter to interpret the artificial impact experiment. In addition, to estimate the position of DCAM3 itself, images of a part of 1999JU3 surface should be taken by DCAM3. DCAM3-D is, therefore, prepared for imaging three objects with different radiance in different positions: impact ejecta, floating SCI, and the surface of 1999JU3 including the crater cavity produced by SCI. In this presentation, we introduce how to predict the radiance of these three objects and the imaging strategy of DCAM3-D based on the prediction.

SCI is approximated by a cylinder of 15 cm x $\phi$ 30 cm, smaller than the pixel resolution of DCAM3-D located at a distance of $\simeq$ 1 km, but Beta cloth with a diffusive reflectance of $\simeq$ 80 % is attached on the lateral surface of SCI. Assuming SCI surface is a uniform diffuse reflector (i.e., lambertian), we estimate the radiance of SCI and the signal to be detected with DCAM3-D. Since 1999JU3 is a C-type asteroid, its surface is dark with a geometric albedo ˜0.05. We estimate the radiance of the surface of 1999JU3, assuming Hapke model with Hapke parameters for 1999JU3 [3] as well as other C-type asteroids [4, 5] and comets [6, 7]. It is difficult to predict the radiance of ejecta because we have not yet known the surface condition producing ejecta and the size and the material property of grains consisting of ejecta from 1999JU3. On the other hand, a preliminary trial to generally construct a light scattering model of impact ejecta is in progress by means of Monte Carlo method [8]. We use such preliminary results to estimate the ejecta radiance.

These radiance predictions were checked by some experimental tests and reflected to the imaging strategy of DCAM3-D, namely to decide imaging parameters such as timing, exposure time, and gain setup. Consequently, we prepared three imaging modes specialized for each imaging object: SCI mode, ejecta mode, and 1999JU3 mode. These modes were adequately mixed in a sequence of 1 fps imaging to cope with every situation we can assume at around the time of SCI impact. Since we have no route to access the FPGA of DCAM3 in space, its imaging parameters had to be completely set up before launch. That is, we have already released the shutter of DCAM3. GOOD LUCK!

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