CONTROLLED COLOR MOSAICS OF VESTA WITH DAWN FRAMING CAMERA IMAGES.

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Introduction: The focus of this work is to process the Dawn Framing Camera (FC) multi-band data for Vesta to improve spatial, spectral, and photometric accuracy and create global clear and 7-color mosaics at the best resolution possible (using images at ~60 m/pixel acquired during the High Altitude Mapping Orbit phase). Our end goal is to investigate two science questions: 1) model and constrain the anomalous photometric behavior of Vesta's surface using FC clear and color images, 2) investigate the effects of space weathering on the regolith using protocols successfully applied to other basaltic bodies in the Solar System (e.g., Moon). The composition of the color units seen on Vesta can be analyzed with more accuracy with a controlled mosaic created with color images that are accurately registered to the shape model. Images are processed using USGS ISIS version3.

Vesta Shape model: We built an updated version of the shapemodel of Vesta with stereophotoclinometry (SPC) using all the FC clear filter data from the Vesta phase. We improved as many artifacts as possible that were located in craters. We generated new SUMFILES and new SHAPE.txt containing the Vesta shapemodel that we converted to a new version of a Digital Shape Kernel (DSK) SPICE kernel (.bds) using NAIF routines. From the SPC, one SUMFILE is generated for each image and contains a summary of the results for the SPC solution with updated ephemeris for camera pointing (CK) and position of the spacecraft (SPK) and list of all the landmarks detected in the image. The ephemeris contained in the SUMFILE can be used to update the instrument pointing and spacecraft position in the corresponding ISIS image cube. This approach applies Gaskell's global control network solution derived from SPC processing to ISIS image data for better image-to-image registration. To fully utilize the new DSK shape model, we added direct support for the DSK format to ISIS3. This addition greatly improves geometric quality of the image dataset because of existing problems with the current ISIS DEM implementation to orthorectify and reproject Dawn FC images. The DSK format allows the representation of the shape as a collection of triangulated plates. This allows for more precise definition of the shape and fewer artifacts when building an image mosaic

Updated ephemeris: In order to use the SUMFILES created during the construction of the shapemodel (for clear images) or created by registering to the clear images (for color images) to update the SPK and CK kernels (spacecraft position and pointing), we implemented a new routine in ISIS3 called *sumspice*. This process involves updating the pointing of the instrument and position of the spacecraft from the contents of the SUMFILE directly in the ISIS image cube files. Since the pointing and position are updated by SPC techniques that are used to generate the shape model, the revised ephemeris in the SUMFILEs will improve individual image geometry and correlate highly with the SPC shape model. This application is used instead of the more difficult and error prone process of creating CK and SPK kernels using NAIF programs. However, *sumspice* was initially developed for Hayabusa AMICA images and the timing in their SUMFILEs corresponds to the middle time of the images. For the Dawn FC images the timing is the start time so we implemented changes in the routines to make the SUMFILEs useable for FC images.

Registration of color images: We tested our registration procedure on color images from HAMO2 cycle 6 (1957 images). We prepared the images to register and created new SUMFILEs using different SPC routines. We then registered color images by running a third SPC routine that aligns images on landmarks accurately. For a given image, the routine adds detected landmarks in the SUMFILE and update position of the image in the SUMFILE after applying auto-alignment. During this process, we check the quality of the correlation with the landmarks and remove poorly correlated landmarks from the list in the SUMFILE. This routine was used in parallel mode to process images faster for all the HAMO2 color data. We used all the SUMFILEs from clear images along with the IAU shape model as a basis for the color images registration. The use of ephemeris data from the SUMFILEs for all the FC images allow for better image-to-image registration. We checked the quality of image-to-image registration we obtained for the HAMO2 dataset using *sumspice*. False color composite images show improvements, e.g., topographic features such as crater rims disappear and color differences due to regolith properties stand out. We will produce an average mosaic for each filter (computing an average using all the images for a specific filter for each pixel), the sharper the surface features appear the better the registration is. We will also apply photometric corrections to remove the effect of illumination conditions, which is necessary for accurate compositional analysis. Our primary data product will be archived in the PDS: a color mosaic of Vesta with orthorectified data (topographic distortions and camera distortions removed) in units of reflectance (I/F).

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