

Restoration of highest-resolution images of Phobos observed by the High-Resolution Stereo Camera (HRSC) onboard Mars Express

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Spacecraft camera images generally contain imaging artifacts (e.g., distortions, blurs, and noises) which can substantially affect the accuracy of image-based measurements (e.g., crater counting) and their higher-level products (e.g., a global image mosaic). On 23 July 2008 (orbit 5851) and 9 January 2011 (orbit 8974), the Mars Express spacecraft acquired highest-resolution (~0.9 m/pixel) images of Phobos surface by the Super Resolution Channel (SRC [1]) of the High-Resolution Stereo Camera (HRSC [2]). Despite their high spatial resolution, previous studies have not investigated these SRC images because they contain severe pepper noises (“blemish” pixels [1]) and motion smears. However, the surface of Phobos is covered by a number of small craters, roughly circular or oval in outline, which enables us to estimate a point spread function (PSF). Thus, the objective of this study is to characterize and reduce these artifacts with the estimated PSF and to restore high-quality SRC images.

We selected ten raw datasets of highest-resolution SRC images, removed pepper noises from them by using a boxcar filter, and tested several deconvolution techniques (e.g., blind deconvolution, Wiener filter, iterative Lucy-Richardson method) assuming a linear PSF, which we found by try-and-error. Here, we report the results from the deconvolution of the SRC images and discuss the advantages of our method.

References

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