Improving Images for Huygens' Descent Imager and Spectral Radiometer

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In less than three years, the Descent Imager and Spectral Radiometer on the Huygens probe will reveal close-up images of Titan's surface with three cameras, imaged onto the same CCD with optical fibers. Due to Titan's winds, the path of the descent allows the cameras to collect data about Titan's surface features over a large area. However, the limited data rate constrains our choice either transmitting images of a small fraction of the area seen by Huygens, or reducing the data in each image by data compression. We report our recent investigations to significantly improve the coverage of Titan's surface without a major sacrifice in image quality.

DISR was originally designed to transmit images with a data compression ratio of eight, which allows the transmission of most of the features seen by the cameras. When we tested the cameras before launch, it became clear that such a high compression ratio can cause such serious image degradation that we decided to go with an average compression ratio of four, a compromise between moderate coverage of Titan's surface and moderate image degradation. Since the requested compression ratio can still be uplinked to the probe, our decision was not necessarily final.

During the last six months, we investigated the compression and decompression algorithm in order to understand typical image defects in our test images created by data compression. Most obvious were sharp defects every 16^{th} row and every 16^{th} column, as well as vertical streaks and a grainy, noisy appearance. Our investigation was complicated by the fact that the compression hardware and decompression software was delivered by another group to us as a "black box", designed to work well for a set of standard test images. Indeed, the compression and decompression algorithm worked well for those test images, but not so well for images taken through the DISR cameras.

Our investigations revealed that that the problem is not in the data compressor, which is on its way to Titan and cannot be changed any more. The problem is that the decompression software is not ideally suited for all kinds of images, particular images taken with the DISR cameras. We identified the major imperfections of the existing software and added a program that significantly decreases image defects.

Our tests with the improved decompression software showed that DISR images can be compressed by a factor of about six before image defects become noticeable. Thus, we will be able to retrieve almost the full coverage of Titan's surface seen by the cameras with images of high quality and very few defects.