Critical Features in the Imagers of the DISR on Huygens

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On January 15, 2005, the Descent Imager and Spectral Radiometer on the Huygens probe took 600 images of Titan with three cameras: a wide-angle camera with ~60 degrees field of view looking to the horizon, a medium-resolution camera with ~40 degrees field looking half way down, and a high-resolution camera with ~20 degrees field looking almost vertically down. All three cameras used optical fibers to put their image onto the same CCD. All images were of high quality with signal-to-noise ratios per pixel of typically 100-200.

The data volume for the images was limited to 3 Mbytes. In order to pack 600 images into this volume, images had to be highly compressed to 1 bit/pixel. This was achieved by an adaptive software program which reduced data numbers of 12 bits down to 8 bits and a hardware package that reduced this further down to 1 bit by using a discrete fourier transform. Such high compression ratios are inherently dangerous to apply in the sense that a handful of bad pixel could corrupt the whole image. We found one such devastating feature of the compressor late in the assembly process, and in an almost last-minute effort we were able to correct it.

Processing of highly compressed images has remained a challenge for us. Slowly we are approaching our goal of revealing most recorded features in the images without showing any artifacts. Despite the experience gained from handling images of the Arizona desert from test flights with a helicopter, the images of Titan posed challenges of a different kind due to the thick atmosphere of Titan. In a vertical column, Titan's atmosphere contains 20-50 times as much gas and aerosols as Earth's atmosphere.

While the imagers were not designed to work after touch-down on Titan's surface, the camera continued to take images, and those images turned out to reveal features on Titan's surface as small as a few millimeters. Originally, we estimated that the cameras were only 30 cm above the surface, and thus all visible features such as rocks should be quite small, about five times smaller than what they may appear to be, considering that our eyes are typically about 150 cm above the surface. Recently, however, we applied two methods of distance estimation to the images which indicate that the cameras may have been 45 cm above Titan's surface. This would increase all size and distance estimates by 50 percent. The first method uses measurements of the apparent defocus of the High Resolution Camera as a indicator of distance. The second method uses triangulation by trying to identify the same features in two cameras with a little overlap in their fields of view.