



Mars surface cameras from Pathfinder to Phoenix

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Twenty years after the two Viking landers returned the first ever images from the surface, a series of spacecraft have continued exploring Mars from the vantage of a robotic “person” on the ground. Pathfinder was appropriately the first of this new group which opened the door to ever higher fidelity images. The next mission, Phoenix, which will land on the unexplored northern plains in 2008, has cameras that derive heritage from all these new missions.

The Pathfinder IMP camera was developed in 1994-5 at a time when CCDs in space were still a new concept. Fortunately, the CASSINI Huygens descent imager DISR led by M. Tomasko at the University of Arizona UA was in development using a detector package from H. U. Keller at the Max Planck Institute of Aeronomy MPE (now, Solar System Studies). The IMP team formed a partnership with Keller that continues to this day and re-packaged the 256 x 512 pixel CCD into a Mars surface camera on a deployable mast. To reduce complexity, the single chip was used for both eyes of the stereoscopic system, 256 x 256 pixels each. Individual images were small and of poor resolution, but a mosaic of several hundred of these postage stamps gave a very satisfactory panorama. The camera successfully tracked the Sojourner rover for 83 sols in 1997 until mission end.

The next mission to Mars, Mars Polar Lander 1999, was designed to explore the sub-surface of the southern polar layered terrain. A nearly exact copy of IMP, now called the Surface Stereo Imager SSI, was augmented with a close up camera with a focusable lens on the robotic arm RA. The RA camera RAC was positioned on the wrist of the RA and provided views of the surface during the digging process and documented the samples delivered to instruments on the deck. MPE was responsible for the design and construction of the RAC. MPL failed to land successfully.

Yet during this time our UA/MPE team was designing an upgraded RAC that replaced the small lamps used to illuminate the surface and scoop interior with LEDs, red, green, and blue. This new version was slated to fly on the 2001 lander mission. NASA canceled this mission in the wake of the MPL failure.

In the final transformation of the SSI, the Phoenix mission has upgraded the detector package to match the MER performance of 1000 x 1000 pixels per eye. This panoramic camera plus the 2001 RAC will provide the eyes for Phoenix. Additionally, the RAC electronics will read out a second focal plane in the MECA microscope providing resolution of soil samples to 4 microns per pixel.

Future missions are likely to take the next step in camera development adding features that we expect in commercial cameras. Yet these rugged cameras have reliably given us our first views of Mars over an exciting time in planetary science.