THE ROBOTIC ARM CAMERA FOR MARS SURVEYOR 2001. P. H. Smith[1] and H. U. Keller[2], [1]Lunar and Planetary Lab, University of Arizona, Tucson, AZ 85721, psmith@lpl.arizona.edu, [2]Max Planck Institute for Aeronomy, Katlenberg-Lindau, Germany.

Introduction: The Mars Surveyor 2001 mission will include a robotic arm with a camera attached to the wrist. The Robotic Arm Camera (RAC) is a build-to-print design based on the MVACS camera from the Mars Polar Lander mission. As with MVACS, it is a collaboration between the University of Arizona and the Max Planck Institute of Germany. It has 3-color LED lamps positioned on the front and a focusable lens that allows objects from 11 mm in front of the housing out to infinity to be brought into sharp focus. RAC supports the mission by monitoring the trench digging process, first surveying the work area with overlapping images that can be rendered into a range map, then imaging the sidewalls and bottom to look for fine-scale structures. The camera can be used to obtain about half of a horizon panorama, and by overlapping the frames these can be in stereoscopic mode. It can also view the scoop edge to give microscopic, color images with 23 micron per pixel resolution.

Science Goals: The science goals for the RAC include analyzing the low resolution panoramic views to learn about the local geomorphology, close up imaging of the digging area and the trench to learn about the surface and sub-surface stratigraphy, and obtaining microscopic views of the soil at different depths to study the size and shape of grains. In looking at the stereoscopic, panoramic views RAC will give a quick overview of about half of the local terrain. The arm cannot be pointed across the lander for safety reasons, but the views it provides give a unique perspective of the local landscape. The arm can be positioned both low and high when scanning to show features from standing height and "dachshund" height. The views are panchromatic, with a bandpass between 400 and 700 nm.

Since the arm is slightly less than 2 m in length, the digging area is tightly confined and the closeup views for RAC are restricted to this pie-shaped area. The ability to make stereoscopic views by overlapping frames allows the camera to characterize the digging area that is invisible to PanCam, including underneath the lander. Therefore, RAC becomes a useful tool for learning about the fine-scale structures of the surface, and by looking into the trench, the sub-surface soil horizons. As the trench deepens, it will be possible to use the LEDs built into the face of the camera to illuminate the trench bottom and make true-color images.

At selected levels on and below the surface, samples will be scooped up and retracted to place the scoop blade directly in front of RAC. By refocusing the lens to its microscopic position, the resolution can be increased to a maximum of 23 microns per pixel. LEDs are angled to illuminate the scoop blade in this position allowing individual grains to be analyzed. The shapes and fracture-types within these grains will give clues to the weathering history and composition of the soil.

MECA Support: The MECA instrument, the Mars Environmental Compatibility Assessment provided by the HEDS group at NASA, requires samples from the robotic arm to perform its scientific experiments. It has an internal microscope with 4 micron per pixel resolution that looks at various substrates coated with soil provided from the trench by the robotic arm. The microscope also has 3-color LED illuminators plus a UV lamp that will show any fluorescence in the grains. In addition, there are 4 chemistry cells with water reservoirs that need soil samples. The delivery of these samples is monitored by the RAC camera that provides an initial assessment of the type of soil in the scoop. If this sample is judged inadequate then the surface can be re-sampled before using one of the precious wet chemistry cells.

The interaction between the RAC and the MECA microscope gives a range of resolutions that start from the panoramic camera views of the local terrain to trench and soil close ups finally to microscopic views. This tremendous range in scale is heretofore unprecedented.

Operations: The RAC assists in the digging of the trench and provides support for sample delivery to MECA. In addition, it views the abrasion patches underneath the scoop, which can be rubbed against both soil and rock, and the adhesion patches on the lander deck. Normally these scenes are too bright to allow the lamps to be effective, but with nighttime operations RAC can obtain high quality color images of any nearby target.

Only the RAC can take images underneath the lander. These views may reveal the indurated soils seen at the Viking lander sites, or other subsurface structures. In addition, the RAC can be position to obtain unique scattering geometries to aid in deciphering the photometric functions of the soil.

The RAC camera is useful for its range of focus and its mobility. These properties will enhance every phase of the mission.