

The Cyborg Astrobiologist: Algorithm Development for Autonomous Planetary (Sub)surface Exploration

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There is significant debate in the Mars exploration and robotics community concerning the degree to which scientific autonomy should be developed and implemented for such missions as MSL'2009 and its successors. Indeed, the autonomy of the MER missions in 2004 has been limited to hazard avoidance; yet with the direction of a large team of human roboticists and planetary scientists on the Earth, these missions have been highly successful. However, we believe that continued development of autonomy measures is worthwhile, especially to augment the human decision-making skills. In 2004, we tested the 'Cyborg Astrobiologist' (CA) at a gypsum-bearing outcrop near Rivas Vaciamadrid. The Cyborg Astrobiologist is a wearable computer and robotic video camcorder system that we are using to test and train a computer-vision system towards having some of the autonomous decision-making capabilities of a field-geologist. The CA platform has thus far been used for testing and development of these algorithms and systems: robotic acquisition of quasi-mosaics of images, real-time image segmentation, and real-time determination of interesting points in the image mosaics. The Cyborg Astrobiologist has demonstrated its ability of finding genuinely interesting points in real-time in the geological scenery, and then gathering more information about these interest points in an automated manner¹. Particularly, the system was able to autonomously identify as unusual, and then proceed to study further, two mid-sized dark regions on the outcrop. These two dark regions were caused by water leaking out of the outcrop. We are currently pursuing further field tests in Guadalajara. We are also further developing our algorithms for semi-autonomous subsurface exploration near the Rio Tinto.

¹McGuire *et al.*, "The Cyborg Astrobiologist: First Field Experience",
International Journal of Astrobiology, vol 4, issue 1 (2005, in press).