An obstacle detection system using binocular stereo fisheye lenses for planetary rover navigation

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In this paper, we present an implementation of an obstacle detection system using binocular stereo fisheye lenses for planetary rover navigation. The fisheye lenses can improve image acquisition efficiency and handle minimal clearance recovery problem because they provide a large field of view. However, the fisheye lens introduces significant distortion in the image, and this will make it much more difficult to find a one-to-one correspondence. In addition, we have to improve the system accuracy and efficiency for robot navigation. To compute dense depth maps accurately in real time, the following five key issues are considered: (1) using lookup tables for a tradeoff between time and space in fisheye distortion correction and correspondence matching, (2) using an improved incremental calculation scheme for algorithmic optimization, (3) multimedia instruction set(MMX) implementation, (4) consistency check to remove wrong stereo matching problems suffering from occlusions or mismatches, (5) constraints of the recovery space. To realize obstacle detection robustly, we use the following three steps: (1) extracting the ground plane parameters using Randomized Hough Transform, (2) filtering the ground and background, (3) locating the obstacles by using connected region detection. Experimental results show the system can run at 3.2fps in 2.0GHz PC with 640X480 pixels.