Low-Cost Stereo Vision on Reconfigurable Hardware

Chris Murphy, Daniel Lindquist, Ann Marie Rynning, Thomas Cecil, Sarah Leavitt, Mark L. Chang
Franklin W. Olin College of Engineering, Needham, MA 02492

Objectives

Obtaining an accurate, three-dimensional model of unstructured outdoor environments has long been a challenge in field robotics. Here, we present a low-cost stereo vision implementation suitable for use in autonomous vehicle applications. The final prototype of this low-cost stereo vision on reconfigurable hardware utilizes low-cost automotive-grade CMOS cameras and a Xilinx Spartan-3 FPGA to process 320x240 pixel images at greater than 150 frames per second. Through a USB 2.0 interface, the prototype is more than capable of delivering real-time depth maps to a host computer for visualization.

The Physical Prototype

The image pair is simultaneously acquired from two cameras. Correspondence calculations and disparity determinations take place on the FPGA. The results may be used to guide autonomous vehicles, and as shown above, may be viewed on a laptop.

Algorithm Implementation on the FPGA

Top-level Block Diagram

Census Transform Module

Hamming Distance

Image Results

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