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# 基于FPGA的立体视觉匹配的高性能实现

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# High Performance Implementation of Stereo Vision Matching Based on FPGA

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摘要 立体视觉系统在3维场景信息感知中起着重要的作用。其中立体匹配算法的运算复杂度较高，实时处理需要硬件实现匹配运算。但在现有的不多实现中，性能要求和硬件资源的矛盾突出。随着分辨率的增加，对处理速度和视差搜索范围都有更高的要求。对此，该文提出了一种立体匹配硬件实现结构，通过并行化算法子模块和合理安排流水结构来提高性能。匹配算法引入了自适应相关窗口的匹配策略，提升了深度不连续区域的视差质量。该方法结合左右一致性校验准则，可有效去除大部分错误匹配结果。整个匹配流程在单片现场可编程门阵列(FPGA)上实现，并在有限硬件资源条件下将视差搜索范围扩大到128像素。系统时钟60 MHz时，对于512×512分辨率的立体图像，系统可以实现60帧/秒以上的处理速度。

关键词： 图像处理 立体视觉 实时性 FPGA 自适应相关窗口

Abstract： Stereo vision system plays important role in three-dimensional information perception. Due to the high computational complexity, real-time processing of stereo vision needs to use dedicated hardware. However, performance requirements conflict with hardware resources in existing implementations. With the resolution increased, system requires larger disparity range and higher processing speed. In this paper, a stereo vision implementation is proposed using fine-grain pipelined structure and sub-module parallelism to improve performance. The implemented matching algorithm used adaptive correlation window strategy to raise disparity quality at object borders and integrated left-right consistency check to reduce possible errors in general. The entire stereo matching process is realized using a single chip of Field Programmable Gate Array (FPGA) and extended disparity search range to 128 pixels under limited resources. The matching process is capable of generating disparities at more than 60 frames per second on 512×512 images when clocked at 60 MHz.

Keywords： Image processing Stereo vision Real-time FPGA Adaptive correlation window

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