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嵌入式3D图形加速器几何引擎算法研究与硬件设计实现

The study of embedded 3D graphics acceleration-geometry engineer algorithm and VLSI design

郭秋丽

指导教师：汤碧玉

专业名称：通信与信息系统

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摘 要

计算机图形学主要以硬件设备的发展为基础，以应用需求为巨大的驱动力，两者相互存在相互影响。由于软件水平的提高，计算机图形的绘制越来越依赖于图形硬件的发展。另一方面，近年来由于导航仪、手机等消费性电子产品上对于三维绘图应用需求的大量增加，如何在嵌入式系统上设计一个低成本的三维绘图加速硬件成为一个重要的议题。嵌入式3D图形加速可以分为几何引擎和渲染引擎两个部分，本文主要对3D图形加速方案中的几何引擎的几何变换、光照和裁剪等核心算法进行了基础性研究。

本文首先回顾了3D图形加速的研究背景、3D图形加速的研究意义、应用领域和当前国内外研究现状， 对几何引擎的核心算法从基本原理和算法上进行了较为详细的介绍，并且给出了坐标转换、光照和裁剪的基本API，就实现的算法原理给予了数学的解释。

其次，本文对几何引擎的核心算法几何变换、光照和裁剪的空间复杂度和时间复杂度进行了分析，在此基础上分析了算法的优劣性，找出了影响算法效率的瓶颈函数，并提出了流水型的并行结构。

最后本文对核心算法进行Handel-C移植，建立了基于Microsoft Visual studio和Celoxcia DK的软硬件协同仿真环境，验证了移植的正确性；并采用Handel-C优化机制对设计进行优化，吞吐率有较大提高；利用DK对Handel-C进行编译，输出的HDL代码在modelsim下仿真，结果正确。

　　　3D绘图；几何绘图引擎；3D加速；

Abstract

Computer Graphics is mainly based on the development of hardware devices, the driving force is the application requirements in which there is an interaction with each other.As the improvement of software, computer graphic drawing depends on the development of graphic hardware. On the other hand, in recent years,because of the increasing demand of 3D graphics applications for navigation, mobile phones and other consumer electronics products, how to design a low-cost 3D graphics acceletaion hardware on embedded systems has become an important project. The 3D graphic acceleration including geometry graphic acceleration engine and rendering graphic acceleration engine.This text mainly discusses the basic core algorithm of geometry graphics acceleration engine such as transformationlighting and clip&culling.

First of all, it reviews the research background of 3D graphic accelerationthe research significances applications and current research status of 3D graphic acceleration, introduces the basic principles and algorithms of the core algorithms in 3D graphic acceleration, elabourates the functions of the basic API, explains the algorithms principles from mathematics.

Secondly it analyzes time complexity, space complexity and parallelism. By consideration of the advantages and disadvantages of this algorithm., the bottleneck functions of affecting algorithm efficiency are figued out, and the idea of using firehose parallel architecture .is also raised.

Finally, it explants the core algorithms to handel-c,constitutes the software and hardware cooperating simulating environment,the environment is based on Microsoft Visual studio and Celoxcia DK which validates the correctness of the algorithms;Then it optimizes the design by adoptting the Handel-C optimizing mechanism, there is a great elevation;At last it compiles the Handel-C using DK, the output datas is simaulated on the modelsim experimental platform, the

correctness of the simulate datas is verified.

Keywords: 3D graphics geometry graphic engine3D accelerate

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