شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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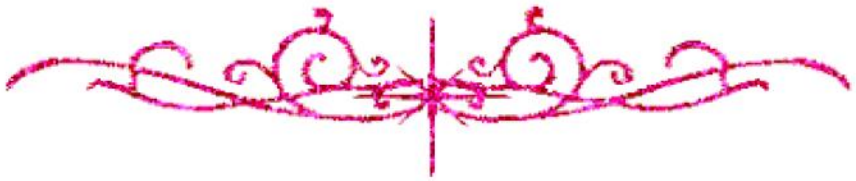
بعض الوثائق الأصلية تالفة



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بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

Performance Evaluation of Parallel Computing For Real-Time Image Processing

By

Amal Elsayed Aboutabl
Assistant Lecturer at the Department of Computer Science
Faculty of Computers and Information, Helwan University

A Thesis Submitted to the
Faculty of Computers and Information
Cairo University
In Partial Fulfillment to the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
In
COMPUTER SCIENCE

Under Supervision of

Prof. Dr. Salwa El-Gamal
Vice Dean for Environmental Affairs
Faculty of Computers and Information
Cairo University

Prof. Dr. Ebada Sarhan
Head of the Computer Science Department
Faculty of Computers and Information
Helwan University

Dr. Mohamed Nour Elsayed Ahmed
Associate Professor of Computers
and Head of the Informatics Research Department
The Electronics Research Institute, Cairo

FACULTY OF COMPUTERS AND INFORMATION
CAIRO UNIVERSITY
EGYPT

2004

Approval Sheet

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Prof. Dr. Ahmed Sharaf Eldin

.....
Prof. Dr. Mokhtar Boshra Riad

FACULTY OF COMPUTERS AND INFORMATION
CAIRO UNIVERSITY
EGYPT

October 2004

Abstract

Real-time applications based on image processing are both computationally and data intensive. This fact presents real-time image processing as a strong candidate for parallelism. In this thesis, real-time image processing is exploited for parallel computing from two different views. The first is loop parallelization since loops are the dominant control structure existing in image processing algorithms. The second is volume visualization which is taken as a real-time image processing workload.

Concerning the loop parallelization aspect, a loop fusion algorithm is proposed. The objective is to fuse loops of the same type (either DOALL or DO loops) considering identical and overlapping bounds. Data locality is enhanced by bringing references to the same data in different loops into a single loop and therefore the need for communication and data replication is reduced. In this work, the iteration spaces of loops before and after using the proposed loop fusion algorithm are executed sequentially and on a multiprocessor computer based on message-passing . The proposed loop fusion algorithm proved to be effective for both sequential and parallel execution, fully and partially overlapped iteration spaces and different types of dependencies. Increasing either the shift size (negative dependence) or the peel size (positive dependence) increases the execution time for the same number of processors due to the resulting reduction in the fused iteration space. The performance improvement achieved by the fusion algorithm increases with the increase in the trip count of the fused iteration space i.e. larger overlap. As the overlap decreases, the gain of fusion diminishes.

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Real-time applications based on image processing are both computationally and data intensive. This fact presents real-time image processing as a strong candidate for parallelism. In this thesis, real-time image processing is exploited for parallel computing from two different views. The first is loop parallelization since loops are the dominant control structure existing in image processing algorithms. The second is volume visualization which is taken as a real-time image processing workload.

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Loop skewing is a loop transformation that reshapes the iteration space of a loop nest. Some loop nests cannot be parallelized if kept in their original form. An analysis and investigation of loop skewing is performed for the objective of exposing parallelism. Unimodular transformation matrices are used to represent loop skewing. Loop bounds of a loop nest are represented as a linear system of inequalities. This linear system of inequalities is solved after applying the transformation to obtain the new loop bounds using the Fourier Motzkin algorithm. A detailed analysis is performed in terms of the shape of the skewed iteration space which is divided into

ng each of which containing a number of steps. The independent iterations, after mpiling, are operated on a simulated message-passing parallel computer. An ration space of two nested loops containing 5000 iterations is used i.e. m*n=5000 re m and n represent the number of iterations of the two loops. Nine different mbinations of m and n are experimented.

The aim of three-dimensional visualization is to effectively display and represent the 3D nature of objects so as to provide for better means for their manipulation and analysis. A technique for parallel volume rendering based on the shear-warp volume rendering technique is proposed. The performance of the proposed technique, which is slices-based, is compared to the existing scanline-based technique using simulation and a set of performance measures such as execution time, speedup, average processor utilization, average processor wait time, average interconnection network utilization and average memory utilization. Four different image sizes (64^3, 128^3, 256^3 and $98x34^2$) and three groups of typical machine simulation parameters are used. For each image size per group, six different shift ratios (0.1, 0.2, 0.3, 0.4, 0.5 and 0.9), reflecting variations in viewing angles, are experimented. A hierarchical cluster architecture with four clusters and four processors/cluster is simulated as well as the proposed slices-based technique and the scanline-based technique. Comparing the the proposed slices-based technique and the existing scanline-based technique, the percentage improvement in speedup is up to 19%.

Certification

I certify that this work has not been accepted in substance for any academic degree and is not being concurrently submitted in candidature for any other degree.

Any portions of this thesis for which I am indebted to other sources are mentioned and explicit references are given.

Student Name : Amal Elsayed Aboutabl

Signature : 

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