Parallelization Approaches using OpenMP for Strassen's Matrix Multiplication and Canny Edge Detector

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This paper gives the overview of standard triple-nested loop algorithm for matrix-matrix multiplication which is well known, well researched and well understood. The Strassen's multiplication is illustrated with sequential algorithm. The parallel implementation of Strassen's multiplication using OpenMP is proposed along with the memory optimizations. Also, we focus on the strategy for parallelizing the canny edge detection algorithm, due to its frequent use in computer vision applications and wide range of opportunities for parallelization. The parallelization strategy examined is loop-level parallelism, which is achieved by the use of OpenMP.

Keywords : Canny Edge Detector, MultiCore, Open MP, Parallelization.

1. INTRODUCTION

At present, multicore clusters are the most relevant option for the deployment of High Performance Computing(HPC) applications, because of their scalability and performance. These applications are usually developed using OpenMP on shared memory, MPI on distributed memory and MPI + OpenMP on hybrid architectures. In this paper, we discuss the parallelization of three algorithms (1) to compute the product of two matrices using the standard triple-nested loop, (2) Strassen's multiplication and (3) Canny Edge Detector (CED)algorithm. For all the three algorithms, besides the brief overview, use of OpenMP to parallelize the given code will be discussed.

Shared memory programming model allows a simpler programming of parallel applications, as the control of data location is not required. OpenMP is the most widely used solution for shared memory programming, as it allows an easy development of parallel applications through compiler directives. It is becoming more important as the number of cores per system increases. To overcome the limitation of shared memory architecture where the performance is measured in terms computational power of single system, the hybrid systems, with both shared/distributed memory, such as multicore clusters, can be programmed using MPI and OpenMP[1,2].

2. RELATED WORK

Loop-level parallelism is well known techniques in parallel programming. Domain decomposition is used for solving computer vision applications [3], while loop-level parallelism is a common approach used by standards like OpenMP [4]. CED is used as a initial phase in several computer vision applications. Many implementations of CED can be found using different languages on different platforms. These implementations usually suffer from a long execution time.

Canny Edge Detector was implemented on a Tilera processor [5], using loop-level parallelism and their implementation is restricted to Tilera64 architecture. CED was also run on a NVIDIA GPU [6], using loop-level parallelism, but it does not produce accurate and

tiplication and Strassen's algorithm. It can be extended by using a variety of matrix types and multicore machines to characterize our study to understand the improved performance benefits of the OpenMP techniques.

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