

A Survey on Image Processing Techniques with OpenMP

Sumit Patel, Dr. M. B. Potdar, Bhadreshsinh Gohil
 Student, Project Director, Assistant Professor
 High Performance Computing
 GTU PG SCHOOL, Ahmedabad, India

Abstract - Image processing is interesting topic in various fields. There are numbers of techniques in image processing, which are useful in medical, remote sensing data processing, engineering, etc. But they take lots of time for processing on images and data. With parallel approach it can be reduced. In this paper, we highlight research of some image processing techniques like SVM (Support Vector Machine), HOG, Kalman filter, Wavelet transform and parallel libraries like OpenMP, MPI and CUDA. From this survey, we see how OpenMP and CUDA are useful in image processing for reducing processing time.

Index Terms - OpenMP, CUDA, Image processing techniques.

1. INTRODUCTION

With advancement in image capturing machines and other technology, image size has increased from past size. For big size data, processing time is longer [1]. Image processing includes image recognition, image detection, face detection, etc. Especially, in image detection time consumption is high. For image detection, various techniques are used like SVM, HOG, BRIEF, etc. It can be reduced with help of parallelization. In general terms, the parallelism means computation done by two or more computing units simultaneously. The parallel computing come by following main approaches: (1) with help of parallel processing equipments and (2) with help of distributed computing system. The first approach is, in which a computer system having two or more processors is used to fulfil computation task. And in other approach, many computer systems (network are using for connected them) are used to accomplish computation task. They have advantages and disadvantages. Selection of architecture is based on behaviour of application and budget [2]. For decreasing time consumption, parallel paradigm such as CUDA, MPI and OpenMP are used. CUDA (Compute Unified Device Architecture) is library provided by NVIDIA. It is used for programming of GPUs, which were used for gaming and high resolution video purposes. But now they are used in parallel processing. MPI is abbreviation of Message Passing Interface. MPI is used in distributed computing. OpenMP is a library used for shared memory architecture. Here, we gave overview of image processing and OpenMP in brief. Also, add survey on various object detection, recognition and image classification techniques with parallel techniques for remote sensing data.

2. IMAGE PROCESSING

Image processing means performed some operations on input data such as image (including photograph or video frame) for getting information and clear image as output. Usually in Image Processing system, when applying already set signal processing methods to images, they are deeming as 2D signals. There are number of growing technologies today, and Image Processing is one of them. And it is curiously growing with its applications in various stages of a business. In medical, computer science and engineering disciplines, Image Processing creates core research area.

Three steps for Image processing: (i) Import images (ii) Analyzing & manipulating images for finding hidden pattern and enhance the images, (iii) Last step is output, in which altered image or other information came out. The aim of image processing include: Visualization - Invigilate the objects those are covert, Image sharpening and restoration - To create a better image, Image retrieval - To counsel for the image of interest, Measurement of pattern - Measures various objects in an image, and last Image recognition - is performed for differentiate and understand the objects in an image. There are two methods in image processing. First method is an Analog, in analog method processing done by human on printouts or photographs and second method is a Digital, in digital method processing done by computer (and/or human) on satellite data or images which are in digital form. In digital image processing, three phases are used namely, (i) Pre-processing, (ii) Enhancement and display and (iii) Information extraction.

3. OPENMP

It is abbreviation of Open Multi Processing. OpenMP is standard Application Programming Interface for developing parallel applications, based on shared memory architecture. It can be extended with help of FORTRAN and C, and C++ languages. When the compiler is not able to find the parallelism, OpenMP is mostly used. It is used for specifying the parallelism in the program explicitly. OpenMP is appropriate for procrssors, which have multi-core architectures. Because of scalability and flexibility, OpenMP is broadly used in processors, which are used for general purpose [3].

OpenMP follows fork-join model for implementation. There are master and worker thread. The master thread specifies the number of worker (fork) threads. After that system divide task among these threads. When parallel region end, master thread

waits for all thread to complete task and perform sequential part of program. Figure 1 and Figure 2 shows the execution model and shared memory model respectively.

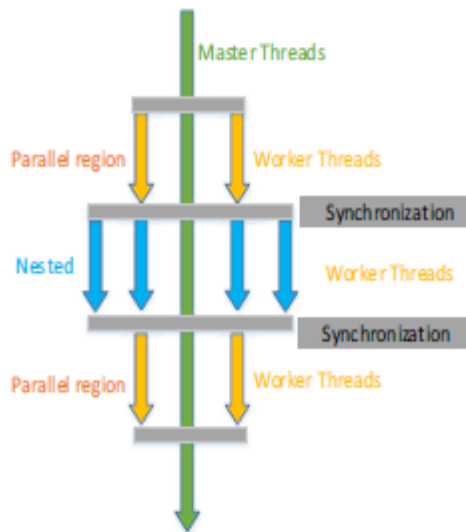


Fig.1 The Execution model

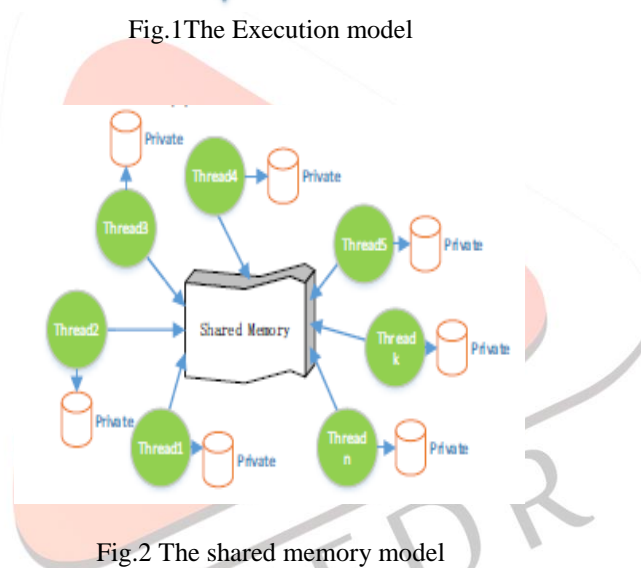


Fig.2 The shared memory model

As shown in below c language code, add #pragma sentinel before loop and use parallel directive of OpenMP. There are shared and private, which are clauses in OpenMP. There is also default, firstprivate, and lastprivate clauses available in OpenMP. Here, we mentioned a code of for loop parallelized with OpenMP, which is in C language:

```
#define number 5 // number varies from 0 to 100
#pragma omp parallel shared(x,y,z) private(j)
num_threads(core_num)
{
#pragma omp for schedule(static) private(k)
for(j=0; j<number; j++)
{
for(k=0;k<SIZE;k++)
z[j] += (x[j][k] * y[j]);
}
}
```

4. IMAGE PROCESSING TECHNIQUES WITH OPENMP

There are many research papers about OpenMP and different techniques of image processing. Object detection and recognition, image classification, image feature extraction are works, which are done in an image processing. For these things, lots of time is required. Here, we mentioned why OpenMP can be useful for reducing time consumption. With multicore and many core processors, OpenMP give notable performance. [5] Specified software parallelism in OpenMP. Authors propose some OpenMP extensions to support Non-Uniform Memory Access (NUMA) architectures (which are main in high-performance many-core platforms). Result shows that with help of these OpenMP extensions, translation from OpenMP to OpenCL can be easy and automatic. Also these extensions improve performance analysis and simplify the automatic translation. OpenCL is a low-level Application Programming Interface (API), which is used in heterogeneous computing and also is used for programming of NUMA. Hadjidoukas and Dimakopoulos use OpenMP for face detection with neural network based algorithm. In sequential programming, only 11 images/sec processing rate can achieve (quad core processor system). While in parallel, real time (≥ 25 images/sec) processing can be perform with 3 or more OpenMP threads [6].

[7] Proposed algorithms for object tracking and detection in camera network. They introduced new object detection algorithm with mean shift segmentation. They also made a new object tracking algorithm using a novel Bayesian Kalman filter with simplified Gaussian mixture (BKF-SGM). Result of the paper show that the proposed object detection algorithm gave better segmentation results over conventional object detection methods and the proposed tracking algorithm can successfully handle complex scenarios and gave good performance. Also there was low arithmetic complexity in newly made algorithm. Liuyang Fang, Mi Wang, Deren Li, and Jun Pan presented research paper on MPI, OpenMP and CUDA (MOC-based) preprocessing of ZSMS images in a system that consists of multiple central processing units (CPUs) and graphics processing units (GPUs). With this method they got the final execution time of the 12 images with four ACRs is 86.10 s, which could provide near-real-time response for the time-critical applications. [9] Performed experiment on wavelet based image segmentation. Then used OpenMP for making parallel image segmentation. They got accurate result with faster execution. [10] Implemented SVM for hyper spectral images using CUDA and OpenMP. SVM training time reduced than other SVM algorithm like cuSVM and P2SVM. SVM is best classifier.

5. CONCLUSION

In this paper, we saw image processing and OpenMP. We also mentioned different methods of image processing. SVM gave better result than other algorithms. Conclusion of this survey is OpenMP and CUDA give faster result than conventional algorithm. Parallel algorithms with CUDA give higher result than OpenMP. But parallel programming with OpenMP is less complex than CUDA programming and OpenMP is available for most processors, which are used nowadays.

6. REFERENCES

- [1] Suli Zhang, Haoran Hu, Xin Pan, "Parallelized Dilate Algorithm for Remote Sensing Image", The Scientific Journal, May 2014
- [2] Harshad B. Prajapati, Dr. Sanjay K. Vij, "Analytical study of parallel and distributed image processing", International Conference on Image Information Processing (ICIIP), 2011
- [3] OpenMP Architecture Review Board. *OpenMP specifications*. <http://openmp.org/wp/openmp-specifications/>
- [4] Minjie Wu, Weiwei Wu, Ning Tai, Hongyu Zhao, Jiawu Fan and Naichang Yuan, Research on OpenMP Model of the Parallel Programming Technology for Homogeneous Multicore DSP", IEEE, 2014
- [5] Pablo González de Aledo Marugán, Javier González Bayón, Pablo Sánchez Espeso and Juan Casal Martín, "OpenMP performance analysis for many-core platforms with non-uniform memory access", International Journal of Computer Science Issues (IJCSI), Vol. 10, Issue 2, No 2, March 2013
- [6] P. E. Hadjidoukas, V. V. Dimakopoulos, "A high performance face detection system using OpenMP", Concurrency and Computation: Practice and Experience, Vol. 21, No.15, Oct. 2009
- [7] Shuai Zhang, Chong Wang, Shing- Chow Chan, Xiguang Wei, Check-Hei Ho, "New Object Detection, Tracking, and Recognition Approaches for Video Surveillance Over Camera Network", IEEE SENSORS JOURNAL, VOL. 15, NO. 5, MAY 2015
- [8] Liuyang Fang, Mi Wang, Deren Li, and Jun Pan, "MOC-Based Parallel Preprocessing of ZY-3 Satellite Images", IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, VOL.12, NO. 2, FEBRUARY 2015
- [9] Priya P. Sajan, S.S. Kumar, "Experimental Study on Parallel Wavelet Based Image Segmentation Using Openmp", IEEE, 2014
- [10] Kun Tan, Junpeng Zhang, Qian Du, Xuesong Wang, "GPU Parallel Implementation of Support Vector Machines for Hyperspectral Image Classification", IEEE, 2015