Template Matching of Aerial Images using GPU

During the last decade, processor architectures have emerged with hundreds and thousands of high speed processing cores in a single chip. These cores can work in parallel to share a work load for faster execution. This paper presents performance evaluations on such multicore and many-core devices by mapping a computationally expensive correlation kernel of a template matching process using various programming models. The work builds a base performance case by a sequential mapping of the algorithm on an Intel processor. In the second step, the performance of the algorithm is enhanced by parallel mapping of the kernel on a shared memory multicore machine using OpenMP programming model. Finally, the Normalized Cross-Correlation (NCC) kernel is scaled to map on a many-core K20 GPU using CUDA programming model. In all steps, the correctness of the implementation of algorithm is taken care by comparing computed data with reference results from a high level implementation in MATLAB. The performance results are presented with various optimization techniques for MATLAB, Sequential, OpenMP and CUDA based implementations. The results show that GPU based implementation achieves 32x and 5x speed-ups respectively to the base case and multicore implementations respectively. Moreover, using inter-block sub-sampling on an 8-bit 4000×4000 reference gray-scale image achieves the execution time upto 2.8sec with an error growth less than 20% for the selected templates of size 96×96.