PARIMALA THULASIRAMAN, Univ. of Manitoba, Department of Computer Science, Winnipeg, MB, R3T 2N2
Design, development and implementation of a parallel algorithm for computed tomography using algebraic reconstruction technique

In this work, we examine the design and implementation of a parallel algorithm for reconstructing images from projections using the algebraic reconstruction technique (ART). This technique for reconstructing pictures from projections is useful for applications such as Computed Tomography (CT or CAT). The algorithm requires fewer views, and hence less radiation, to produce an image of comparable or better quality. However, the approach is not widely used because of its computationally intensive nature in comparison with rival technologies. A faster ART algorithm could reduce the amount of radiation needed for CT imaging by producing a better image with fewer projections.

A reconstruction from projections version of the ART algorithm for two dimensions was first designed for a distributed memory machine and implemented in parallel using the Message Passing Interface (MPI). The results produced on the distributed memory machine did not produce faster reconstructions due to prohibitively long and variant communication latency. The algorithm was then redesigned for a multithreaded, shared memory machine and implemented in OpenMP. This version produced positive results, showing a clear computational advantage for multiple processors and measured efficiency ranging from 60–95%. Consistent with the literature, image quality proved to be significantly better compared to the industry standard Filtered Backprojection algorithm especially when reconstructing from fewer projection angles.