3D Macro-Cellular Automata based on Spherical IC Lattices

Andreas Nowatzyk
Compaq Computer Corp. (Western Research Lab)

The problem: Fairly conventional number-crunching, for example super resolution image processing that receives a series of overlapping data samples from devices like CCD cameras, laser scanners, etc. and uses statistical methods to compute the most likely object model that could have produced the observed data. The resulting model object image can significantly exceed the resolution of the input images, as was demonstrated by Cheeseman et. al at JPL with Mars Pathfinder images.

The solution: is a regular, homogenious, three dimensional lattice of fairly simple computing elements that are only connected to their nearest neighbors. Each computing element is limited to a CMOS integrated circuit with about 3 square millimeters of active area. Hence the structure is essentially a cellular automata with a fixed interconnection pattern and modest complexity in each element.

The punch-line, ahh justification: The 3D automata described above is quite far from an ideal DSP architecture. However it closely matches implementation constraints for clusters of spherical integrated circuits (ref. www.ballsemi.com). The promise of ball-IC's is a dramatic reduction in the cost for each device and the ability to be clustered into three-dimensional grids or lattices. Hence the attractiveness of the proposed solution depends squarely on the viability of ball-IC's, which is not yet established. However, it will be argued that in the case that Ball Semiconductor Inc. manages to achieve their objectives, the described architecture offers a significant advantage over conventional approaches in the high-end DSP realm.