Digital Molecular Computer

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Abstract

Boolean satisfiability problem (SAT) is an NP-complete problem which is hard to solve in polynomial time with conventional computers. We propose **D**igital **M**olecular **C**omputer (DMC), an in-memory computing processor, which solves variable-limited SAT problems in polynomial time with current microelectronic technology by novel architecture. Inspired by molecular computing, DMC performs computations by parallel writing operations to multiple memory elements activated according to their addresses. DMC's computations differ not only in different input data but also in locations where it performs. This extra information with a well-designed control unit leads to an outstanding improvement in solving large scale combination problems. With a large number of small memory-computing elements and fine-grained controlling, DMC combines the massively parallelism and efficient organization of molecular computer, and fast speed and programmability of digital computer. Different SAT problems can be solved in a general DMC-architecture processor with different programs due to DMC's programmability. DMC provides an accurate solution and deterministic steps algorithm for SAT problems while past SAT solvers are hard to achieve. We implemented a prototype solving 10-variable SAT problem in the FPGA board.