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An S_n Algorithm for the Massively Parallel CM-200 Computer

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The computational power required for simulating complex nuclear systems has been a limiting factor on their feasibility since their discovery. This article from Los Alamos National Laboratory discusses work using the CM-200 computer system and parallelizing neutron transport calculations on its unique architecture. This architecture requires that each processor executes the same set of instructions, rather than works independently. To accomodate this, the paper discusses how they use a diagonal plane through the mesh, projected onto a 2D array, to allow simultaneous processing. Though this method alone does not provide remarkable parallel computational efficiency (PCE)—only about $\frac{1}{3}$—it can be executed using a pipelining approach to increase PCE to well over 75%. The article presents tests of the algorithm on an experimentally verified test reactor, consisting of a spherical uranium core, surrounded by a beryllium reflector.

I was particularly intrigued by the pipelining discussion provided in the article. The solution presented seemed to be a clever way to make use of the otherwise wasted computation executed on the system. I also found it interesting that the computation efficiency improved in the simulations when the authors introduced the fake X layer, rather than apply a mask to only calculate values for the mesh that were required. This almost counterintuitive approach of "wasting" calculations (but still saving time that otherwise would be spent preventing the calculation) is an interesting phenomenon, and something to consider when writing code in the future. Finally, I would also be curious to note how the computational power available at the time of this article (1998) compares to today. The authors describe the CM-200's 2048 processors as substantial, though by today's standards that is fairly common (I submit small jobs on Titan with more processors), so I'm curious how a computer with 2048 processors compared with leadership class faciliies at the time. (Answer from *Wikipedia*: The largest supercomputer in 1997 was ASCI Red at at LANL; it had 9298 separate processors)