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Project Title

Optimizing *Inexact Parallel Block Jacobi* (*IPBJ*) with Vector-Level Concurrency Calculations

Project Objective

Developing a subroutine for the PARTISN code that performs an *IPBJ* mesh sweep efficiently using vector-level concurrency through angle-first indexing.

Project Description

Transport inner iterations (*SI* or *IPBJ*) rely on mesh sweep algorithms for obtaining iterative solutions. Typically, this mesh sweep is done for the entire spatial domain for a given direction before proceeding to the next direction. This is computationally inefficient though, as the result of one spatial cell's solution is needed to compute the next cell's solution. PARTISN has an optimized sweeper for *SI* that solves all directions in a given spatial cell before proceeding to the next. By using angle-first indexing for the arrays, the data needed for these calculations in a spatial cell is all stored adjacently in the computer's memory, allowing for an increase in computational efficiency by utilizing this vector-level concurrency.

My project is to implement an analogous sweep algorithm into a subroutine for obtaining the *IPBJ* iterative solution. This subroutine uses many elements from the optimized *SI* sweeper, but with a different spatial domain decomposition to reflect the *IPBJ* solution method. One significant consequence of this different spatial domain decomposition is a difference in the communication between processors. Therefore, in addition to the *IPBJ* optimized sweeper subroutine, I am developing a subroutine that handles the communication between processors for the aforementioned subroutine. This project is complementary to my PhD research, which is focused on reducing the number of iterations required by *PBJ-ITMM* in optically thin regions and general reduction in time-to-solution for such problems.

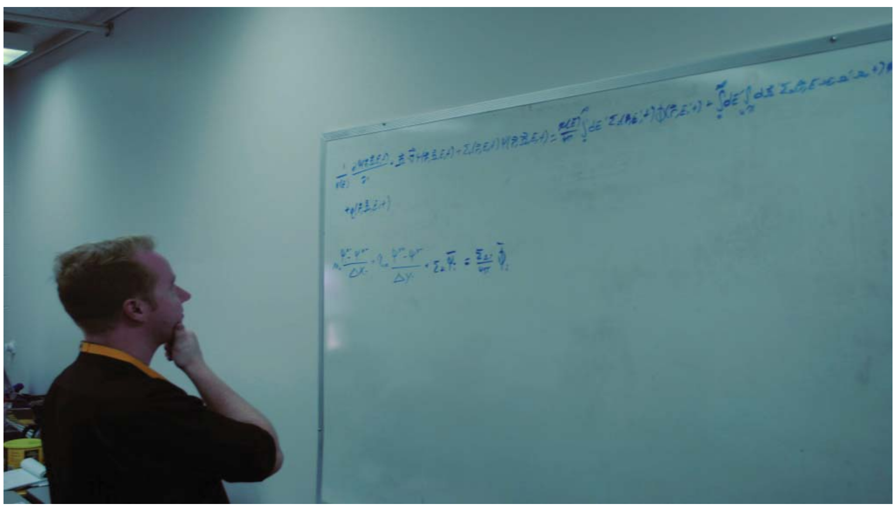
Finally, if time allows, I will implement parallel execution of energy groups that are decoupled through Jacobi iterations for the *IPBJ* solution.

Project Relevance to Nuclear Nonproliferation

The added capabilities to the PARTISN code package are directly applicable to nuclear nonproliferation. Many nonproliferation problems, such as detection problems, rely on robust transport simulations. This added capability to PARTISN allows for these simulations to be completed more efficiently, aiding in nonproliferation tasks that require many transport simulations to be performed.

Products and Outcomes of Project

The product of my internship will be the added capability to PARTISN of the optimized *IPBJ* sweeper. As discussed previously, this sweeper is computationally advantageous due to vector-level concurrency achieved by solving all directions over a spatial cell before moving to the next cell. This should decrease the runtime for PARTISN simulations when the *IPBJ* iterative method is used.



Publications and Reports

D. S. HOAGLAND, "Software Requirements Specification for Parallel Block Jacobi with Angular Vectorization in PARTISN," Los Alamos National Laboratory, Memorandum: CCS-2:17-0017 (July 11, 2017).

Presentations

D. S. Hoagland, "Parallel Block Jacobi with Angular Vectorization in PARTISN", Los Alamos, NM, August, 2017, Los Alamos National Laboratory.