

CS 4970 - Parallel Programming

Assignment 5 - Due 2021.09.27

Overview:

The purpose of this assignment is to complete the parallel finite difference differentiation program.

Background:

You currently have a program which takes data, in the form of an array, and scatters (with `scatterv`) with overlap to all processes. Each process then modifies their share of the data, and stores these results in a non-overlapping array. All of the non-overlapping arrays are then gathered (via `gatherv`) back to process 0. At this point, process 0 outputs the data to a file, where each row of the file is a pair: x y with a space between them. This data format makes it easy for *Mathematica* to import.

Assignment:

Start with your code (or the code I provided), create functions for the seven different finite difference formulas which use 6 points total and are $\mathcal{O}(h^6)$. You are to have each process compute the derivative of the data using the overlapping data, storing the results in the non-overlapping arrays. Each process should use as many points as possible to the left and right (up to 3) in computing the finite difference derivative. In particular, processes with rank greater than 0 and less than `size-1` should be able to uniformly use the center finite difference formula (three to left and three to right) everywhere, while processes 0 and `size-1` should be able to use this formula everywhere except at three points each.

Once the derivative has been computed, output the data to a file in the format described in background. Load this data into *Mathematica* and then graph both $f'(x)$ and the finite difference $f'_{FD}(x)$ approximation to $f'(x)$ together, as well as graphing $f'_{FD}(x_i) - f'(x_i)$ for all points $(x_i, f'_{FD}(x_i))$ in your data set.