Parallel Bio-heat Transfer Solver

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Abstract

The Bio-heat transfer problem is a complex problem which involves multiple phenomenons such as heat transfer due to conduction, convection and radiation in living tissues. Additionally heat generation due to Metabolism and heat transfer due to perfusion are also involved. Experimentally studying this problem by taking readings throughout the body is very challenging and thus Computational methods are used to model them. Since the usage of cell phones has increased tremendously, it is important to know the health risks due to the radiation they emit. And trying to measure temperature changes due to cell-phone radiation is even more difficult as the temperature changes are really small. My research is about studying the effect of cell phone radiation on temperature of the head(modeled as 4-layered sphere of tissues) using numerical methods. This involves solving the Pennes Equation, which has been used to model this phenomenon for more than half a century, with appropriate boundary conditions and thermal properties.

The existing solver solves this equation using Finite Difference explicit method and it uses MPI for parallelization. My project would be to study the bottlenecks of the code and optimize it by using hybrid methods i.e including both OpenMP and MPI for parallelizing. Project would involve studying computational efficiencies and scaling, do load balancing and also study the IO efficiency of the code since the code needs to read input for geometry and power deposited by EM radiations of the Phone.