GPU Solver for SPD Matrices vs. Traditional Codes

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Abstract

In our laboratory we have been extensively using the inverse task to reconstruct thermal boundary conditions at hot surfaces of solid materials. More than a decade of experience and cooperation with industries has proven our experimental/numerical technique to be reliable and very accurate. Until now we have also believed our algorithm originally using the line-by-line method is efficient and fast, regrettably we were wrong. The transient 2D (3D) heat diffusion in a multi-material sample is the most computationally costly ingredient of the algorithm. In the present paper, the potential for speeding up our calculations is manifested by firstly benchmarking it against traditional CFD codes such as OpenFOAM (FDIC) and ANSYS Fluent (AMG). Secondly, we also present a unique comparison with three in-house GPU codes each written by a different PhD student/postdoc of ours. Chronological listed, one student pushed his luck with a fully explicit scheme, while the other two bet on implicit methods namely the line-by-line method in OpenCL and the conjugate gradient method with the deflated truncated Neumann series preconditioner in CUDA.

References

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