Language Agnostic Performance Portability Solution for Heterogeneous Applications

Anshu Dubey[1], Tom Klosterman[2]

[1] Argonne National Laboratory, 9700 S. Cass Ave. Lemont, IL, USA, adubey@anl.gov
[2] Argonne National Laboratory, 9700 S. Cass Ave. Lemont, IL, USA, tklosterman@anl.gov

Keywords: *Applications, Multiphysics, Heterogeneity*

Multiphysics simulation software used on high performance computing (HPC) platforms is in a phase of transformation because of combined increase in the heterogeneity and complexity of models and hardware platforms. Having separate implementations for different platforms is not a good option because of maintainability and portability issues. Computational science community has been looking for mechanisms to express code through abstractions that can be specialized for different platforms. Majority of efforts to date have either used C++ template meta-programming or have developed domain-specific languages [1, 2, 3, 4]. In this presentation, we describe a language agnostic methodology that mimics the behavior of templates as applied in the abstractions described above through the simple expedient of keeping the human-in-the-loop. Our approach does not rely upon automatic inferencing, instead it achieves expressibility by decomposing code snippets into reusable blocks that can be permuted and combined in many different ways. The human-in-the-loop expresses the combination, and the translator tool converts it into a source code that can be compiled by the device compilers. The code snippets can be written in any language, therefore, our tool is language agnostic.

REFERENCES

[1] Earl, C., Might, M., Bagusetty, A., Sutherland, J.C.: Nebo: An efficient, parallel, and portable domain-specific language for numerically solving partial differential equations. Journal of Systems and Software **125**, 389–400 (2017)

[2] Edwards, H.C., Trott, C.R., Sunderland, D.: Kokkos: Enabling manycore performance portability through polymorphic memory access patterns. Journal of Parallel and Distributed Computing **74**(12), 3202–3216 (2014)

[3] Gysi, T., Osuna, C., Fuhrer, O., Bianco, M., Schulthess, T.C.: STELLA: A domain-specific tool for structured grid methods in weather and climate models. In: Proceedings of SC15. pp. 1–12 (2015)

[4] Hornung, R., Keasler, J., et al.: RAJA: Performance portability layer (2020), https://github.com/LLNL/RAJA