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REFACTORING LEGACY FORTRAN APPLICATIONS TO LEVERAGE MODERN HETEROGENOUS ARCHITECTURES IN EXTREME-SCALE CFD

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Recent trends and advancement in including more diverse and heterogeneous hardware in High-Performance Computing is challenging software developers in their pursuit for good performance and numerical stability. The well-known maxim "software outlives hardware" may no longer necessarily hold true, and developers are today forced to re-factor their codebases to leverage these powerful new heterogeneous systems.

In this talk, we present Neko – a portable framework for high-order spectral element flow simulations [1]. Unlike prior works, Neko adopts a modern object-oriented Fortran 2008 approach, allowing multi-tier abstractions of the solver stack and facilitating various hardware backends ranging from general-purpose processors, accelerators down to exotic vector processors[2] and Field-Programmable Gate Arrays (FPGAs)[3] via Neko's device abstraction layer.

We show that Neko's performance and accuracy are comparable to NekRS, and thus on-par with Nek5000's successor on modern architectures. Based on our performance evaluation, we discuss challenges and opportunities for using modern Fortran in high-order solvers on emerging hardware.

REFERENCES

[1] N. Jansson, M. Karp, A. Podobas, S. Markidis, and P. Schlatter, *Neko: A Modern, Portable, and Scalable Framework for High-Fidelity Computational Fluid Dynamics*, *arXiv preprint arXiv:2107.01243*, 2021.

[2] N. Jansson, *Spectral Element Simulations on the NEC SX-Aurora TSUBASA*, In International Conference on High Performance Computing in Asia-Pacific Region, 2021.

[3] M. Karp, A. Podobas, T. Kenter, N. Jansson, C. Plessl, P. Schlatter, S. Markidis, *A High-Fidelity Flow Solver for Unstructured Meshes on Field-Programmable Gate Arrays*, . In International Conference on High Performance Computing in Asia-Pacific Region, 2022.