Performance of OpenMP loop transformations for the acoustic wave stencil on GPUs

J.F.D. Souza 1,2, L.S.F. Machado 1, E. Gomi 2, C. Tadonki 3, S. McIntosh-Smith 4, H. Senger 1,2

1Universidade Federal de S˜ ao Carlos (UFSCar), Brazil 2Universidade de S˜ ao Paulo, Brazil 3Mines Paristech/PSL, France 4University of Bristol, UK

OpenMP and heterogeneous architectures
- The support for heterogeneous architectures was introduced in OpenMP 4.0 and OpenMP 4.5.
- OpenMP 5.1 introduced unroll and tiling loop transformations. Code offloading for these transformations is supported in Clang 13.
- Despite being around for decades, the availability of these transformations for portability across compilers in OpenMP is relatively new. And we exercise it.

The application kernel
Kernel of seismic applications such as full-waveform inversion (FWI) and reverse-time migration (RTM), the propagation of acoustic waves can be modeled as inversion (FWI) and reverse-time migration (RTM), the
Kernel of seismic applications such as in full-waveform

- Performance gains ranged from 1.13x to 2.93x. In most scenarios, the best performance was achieved by combining unroll and tiling.
- The performance of tiling is highly sensitive to the choice of block size.