Application Overview

- Zonal Flow Solver (ZFS): a multiphysics simulation framework for compressible and incompressible flow, particulate flow, aeroacoustics, and combustion phenomena
- In development at the Institute of Aerodynamics at RWTH Aachen University, Germany since 2004
- Wide range of applications in fundamental, technical, and biofluidmechanical problems
- This work focuses on the computational aeroacoustics solver of ZFS which predicts aeroacoustic noise generation [1]

GPU Development

- Offloading of the main kernels (C++ code base) to GPUs with OpenACC
- Required modifications: 1,800 SLOC added, only 6% of which are directives; most changes to enable highly object-oriented code to run on accelerators
- A single NVIDIA P100 GPU outperforms a 2-socket Intel Broadwell system (22 cores @ 2.2 GHz) by a factor of ~1.25 [2]

Productivity Analysis

- Collected data:
  - Pre- and post-knowledge surveys [3]
  - Electronic developer diary: EffortLog [3,4]
  - >500 entries, 65 milestones with performance measurements [2]
  - Port of ~6,500 LOC of the main solver to GPUs with OpenACC in ~600 hours
  - OpenACC makes it feasible to port large C++ code bases to accelerators with reasonable development effort

References


Figure 1: Relative performance over development effort for porting ZFS to GPUs.