POP Success Stories: A Transversal HPC Centre of Excellence in Performance Optimisation

Jonathan Boyle, Sally Bridgwater, Nick Dingle, Wadud Miah, Jon Gibson, Numerical Algorithms Group Ltd, Oxford, UK
pop@nag.co.uk

What is POP?

- A **Centre of Excellence in Computing Applications** – offering world-class expertise to help improve performance of EU HPC and parallel software
- **Free services** for code owners and users from all domains – we make it easier to optimise HPC software
- We are funded by the European Commission

POP success – code improvement

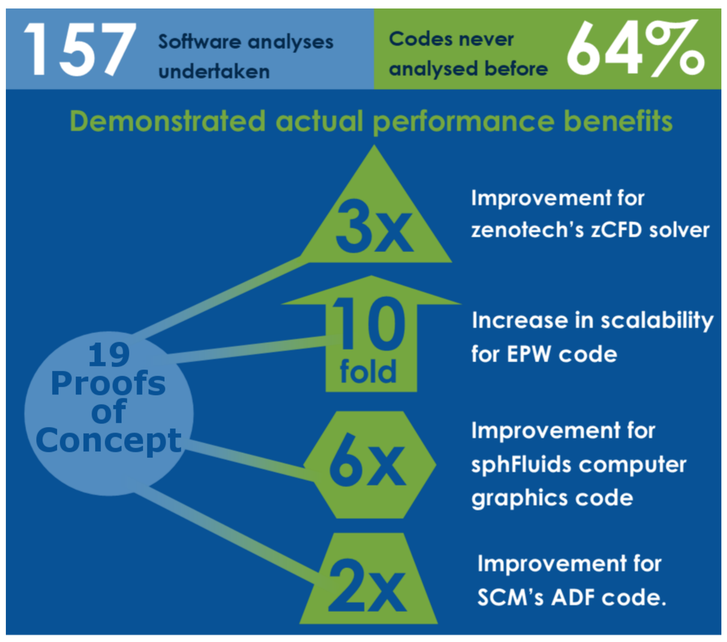
Parallel software performance analysis

- Our *Performance Audits* identify causes of performance bottlenecks
- Our *Performance Plans* identify solutions

Our *Proof of Concept* projects demonstrate the actual performance gains

- 19 undertaken so far
- For examples see highlights on right hand side of poster

For more success stories see the POP website



POP success – training developers

We are improving HPC skills across the EU

- POP face-to-face **training courses**
- POP **Webinars** – recordings available on the website
- The POP documentation library – **learning material** on performance tools and performance analysis.
- Dissemination via our **Newsletter** and **Helpdesk**

We promote HPC best practice

- **The POP Standardised Methodology** – a set of metrics to precisely identify the root cause of performance problems
- **Use of open source analysis tools** to ensure HPC optimisation is available to all

Customer feedback

Customer Advocacy is integral to the POP project, it ensures relevance and quality, and the data will be used to evolve future POP services.

Feedback gathered via SurveyMonkey and phone conversations:

- 90% of customers 'very satisfied' or 'satisfied'
- 98% found POP 'extremely responsive' or 'very responsive'
- 100% considered the quality was 'Excellent' or 'Good'

Customer quotes:

"This audit allowed our team to know where to focus the work."

"The major impact of the audit was a clear insight on the bottlenecks of the code."

"The POP experts did a great job during the performance audit"

"it gave us a lot of information we can directly use to improve the performance of the code"

Proof of Concept Highlights

Highlight 1: GraGLeS2D

GraGLeS2D is a microstructure materials simulation code.

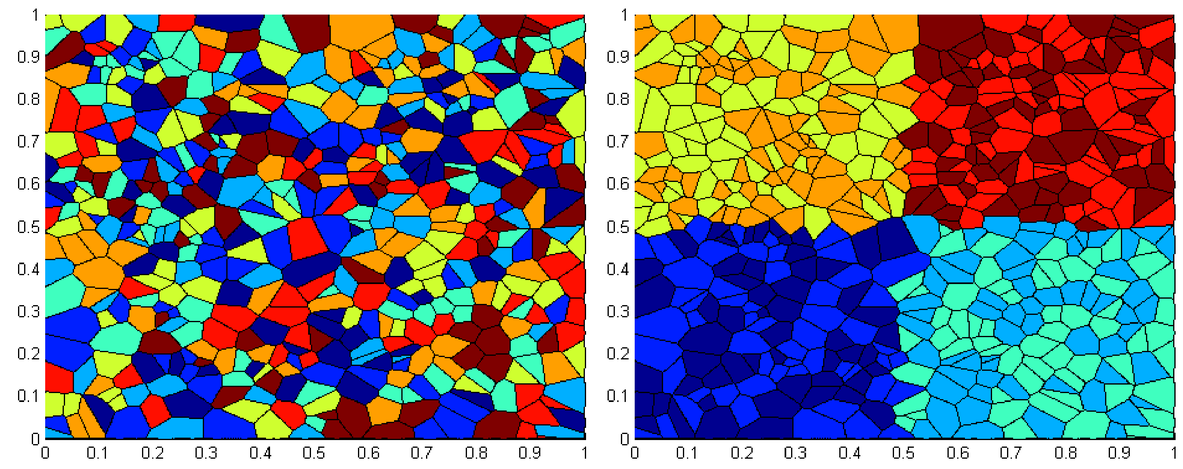


Figure 1: Initial (left) vs. optimised (right) work/data distribution.

We implemented several optimisations, including matching work distribution to data locality. The hotspot's runtime improved by more than 10x.

Highlight 2: Complex matrix multiplication

This work optimised a complex matrix multiplication operating on shared memory arrays within SCM's BAND code.

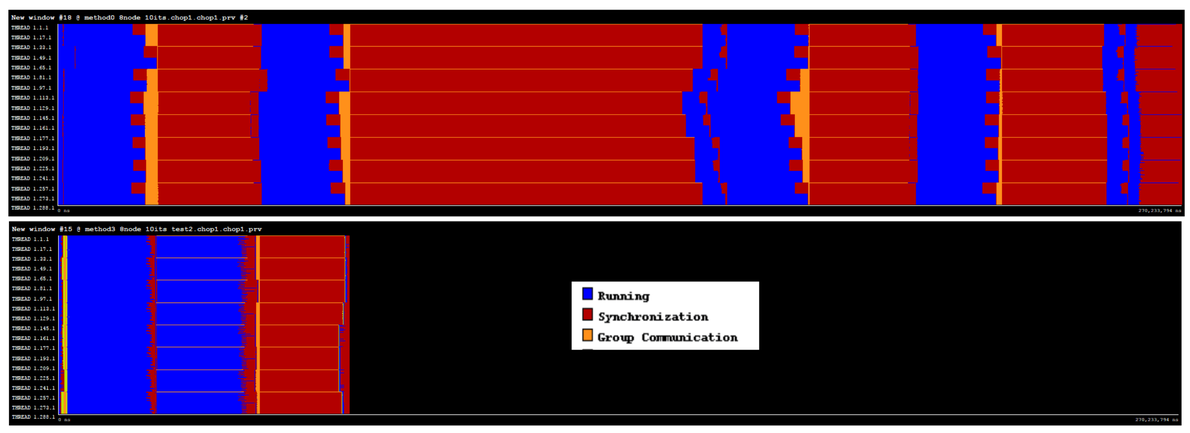


Figure 2: Timeline of initial (top) and optimised (bottom) subroutine call.

Our optimisations removed redundant MPI communication, improved use of dgemm, and overlapped communication and computation, leading to a 4x speed-up for the optimised part of the code.

Highlight 3: zCDF

zCFD by Zenotech is a density based finite volume and Discontinuous Galerkin CFD solver, using MPI + OpenMP. Our performance analysis identified a number of areas for improvement:

- A large % of time in serial execution
- Load imbalance within one OpenMP loop

A 50% performance increase was measured on a small test case (see plot) with a 3x speed-up for production runs.

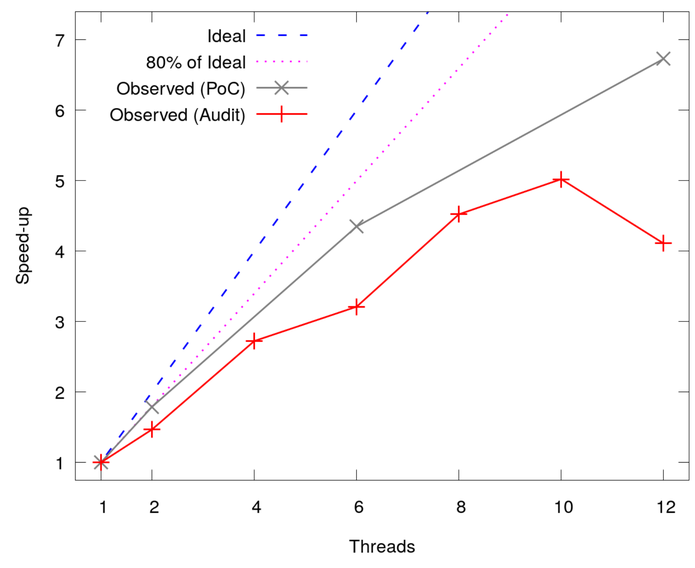


Figure 3: Speed-up plot for initial (audit) and optimised (PoC) software.

https://pop-coe.eu

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