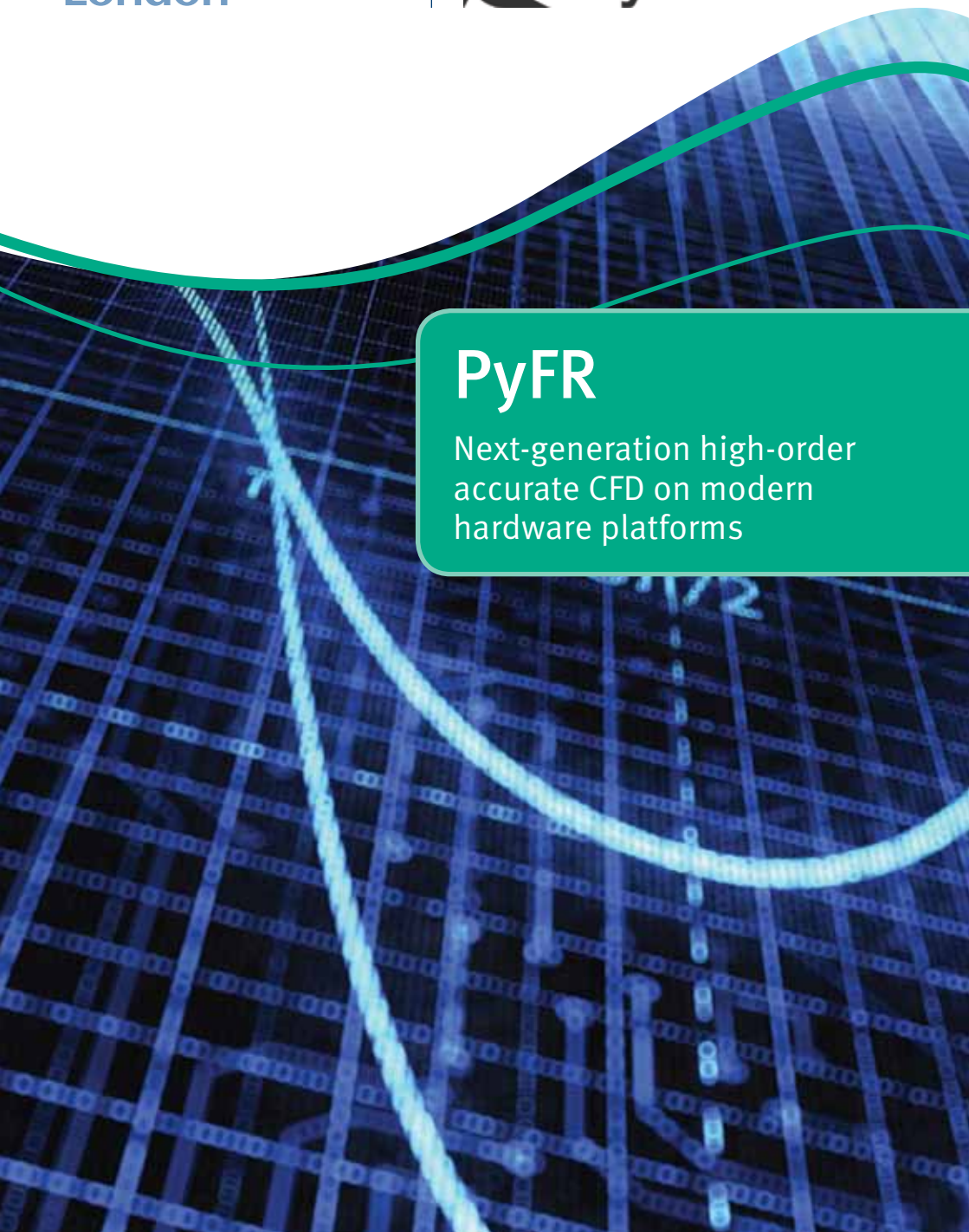
Imperial College London

PyFR



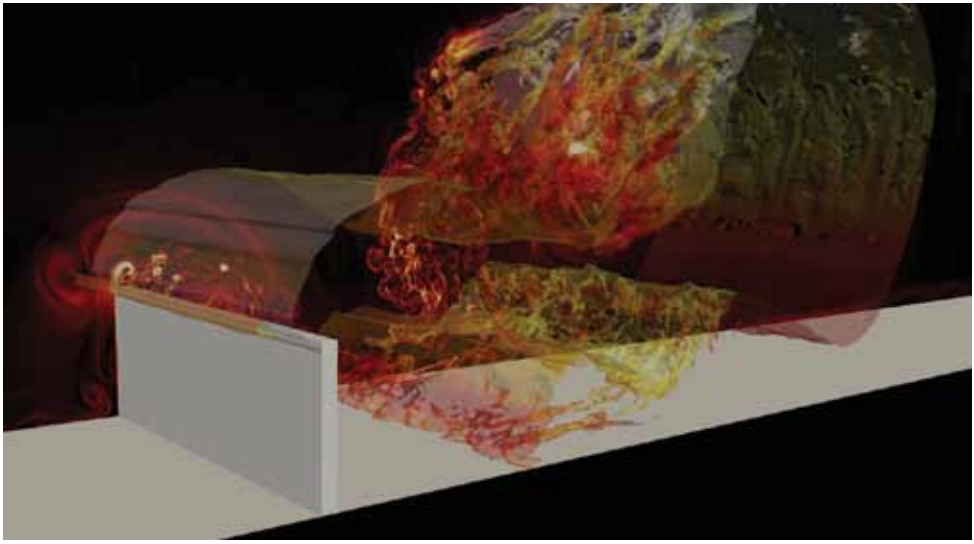
PyFR

Next-generation high-order accurate CFD on modern hardware platforms

PyFR is a fluid flow solver designed to run at arbitrary orders of accuracy in space on unstructured meshes of complex engineering geometries. It is also designed to target a range of both conventional and modern ‘many-core’ hardware platforms (including clusters of CPUs, Nvidia GPUs, and AMD GPUs); all from a single codebase containing just 5,000 lines of Python!

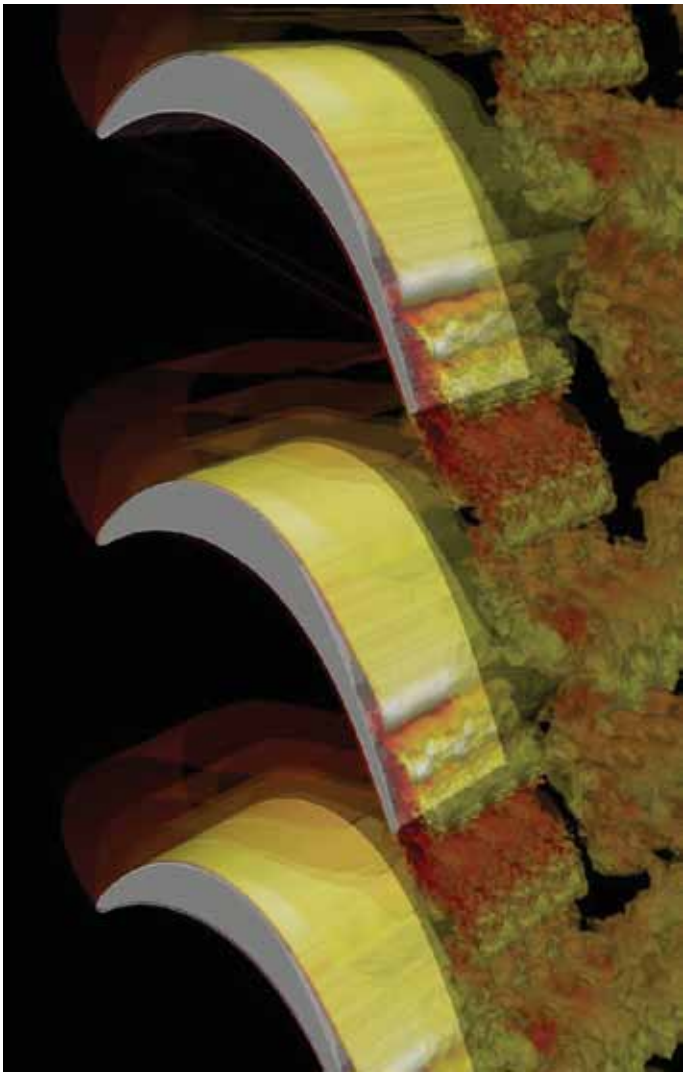
Key features

- Governing equations – compressible Euler, compressible Navier-Stokes
- Dimensionality – 2D, 3D
- Element types – triangles, quadrilaterals, hexahedra, prisms, tetrahedra
- Platforms – CPU clusters, Nvidia GPU clusters, AMD GPU clusters
- Spatial discretisation – high-order Flux Reconstruction
- Temporal discretisation – explicit Runge-Kutta schemes
- Precision – single, double
- Input format – Gmsh (.msh)
- Output format – unstructured VTK (.vtu)



Applications

- Design of next-generation unmanned aerial vehicles
- Design of Formula 1 racing cars
- Design of jet engines
- Aeroacoustics



◄ Flow over a spoiler deployed at 90 degrees to the oncoming flow, computed on a mesh with 1.3 billion degrees of freedom using 184 x Nvidia M2090 GPUs in the Emerald supercomputer.

► Flow over a low pressure turbine blade, computed on a mesh with 85 million degrees of freedom using 4 x Nvidia K20 GPUs in a desktop workstation.

Vision

Current-generation industrial CFD technology (broadly RANS run on CPU clusters) has limited applicability. Specifically, if relevant flow phenomena are fundamentally unsteady, RANS is not fit-for-purpose. Our vision is to develop the de facto industry standard technology for affordable, and hence industrially relevant, high-fidelity scale-resolving simulations of unsteady flow phenomena within the vicinity of complex engineering geometries. We believe this can be achieved by intelligently leveraging benefits of, and synergies between, high-order Flux Reconstruction algorithms for unstructured grids, and modern 'many-core' hardware platforms – such as GPUs. PyFR is our embodiment of this vision in code!

Licence

Industry-friendly open-source New Style BSD.

Contact

Dr Peter Vincent
Department of Aeronautics
Tel: +44 (0)20 759 41975
Email: p.vincent@imperial.ac.uk

@PyFR_Solver

www.pyfr.org
www.prism.ac.uk