

## CFD Modelling at Exeter AMAFS Project

Dr Gavin Tabor, Dr Matt Baker

# Personal History

## Dr Gavin Tabor

- PhD (1994) in Theoretical Astrophysics (Gas dynamics in Galaxies)
- Postdoc work in Engineering CFD : Prof David Gosman (Imperial College) 1994 – 1999
  - Variety of projects including multiphase flow, LES, FOAM
- Appointed to lectureship in Exeter – 1999
  - Research interests; turbulence modelling, code development (OpenFOAM), application in engineering, science + medicine

Group mission statement : to advance theory and application of CFD

# Exeter CFD group

Currently; 5 PhD students, 1 postdoc, 1 visiting PhD student:

- Matt Berry, Dr Mulualem Gebreslassie, Miriam Garcia – Tidal Turbines project
- Shenan Grossberg – Adjoint Optimisation
- Ed Shorthouse – Modelling room environments
- Ben Jankauskas – HDVS as reaction vessels
- Pedro Lopes – Air entrainment

Dr Matt Baker – E&S Lecturer in Engineering – PhD Thesis on CFD simulation of flow through packed beds.

# Group facilities

- CFD Workroom inc. 4 workstations (top spec; dual processor, 96GB RAM)
- Callisto beowulf cluster; 64 cores, 256 GB RAM
- Access to
  - Micro-CT scanner - 3 micron resolution
  - Advanced ALM manufacturing facilities
  - 3d visualisation
  - Zen supercomputer
- Codes; OpenFOAM, Fluent, ANSYS Workbench
- Meshing; Pointwise, ScanIP, ANSYS Workbench, snappyHexMesh

## WP3 – Multiphase Modelling

WP Objective – to provide accurate analysis of the phase change involved in the fuel-cell system to allow accurate prediction of overall system performance.

Elements :

- Small scale simulation of flow through individual elements of HX
- Implementation, testing of multiphase model/phase transfer modelling
- Development of multiscale model for HX

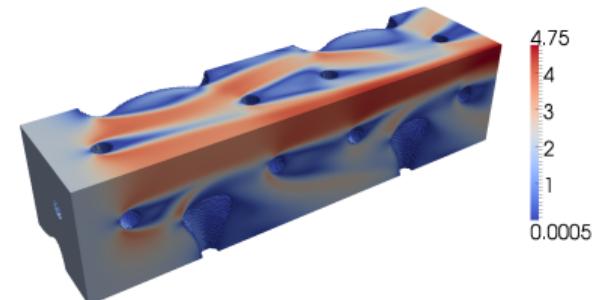
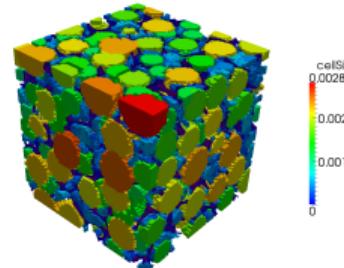
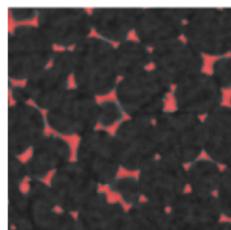
Interaction with parallel KTP project with HiETA

# Porous media

Geometry/mesh construction for complex domains – foams, packed beds

Imaged-Based Meshing tools  
(ScanIP, snappyHexMesh)

Applications for chemical process, catalysis, IC engines etc.



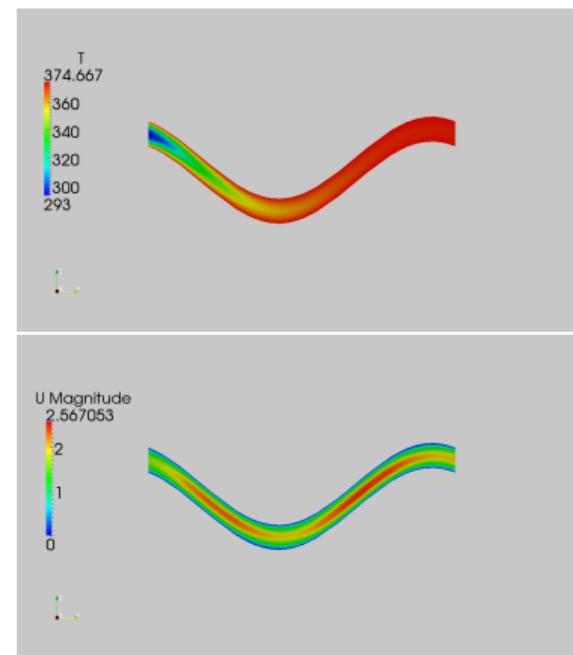
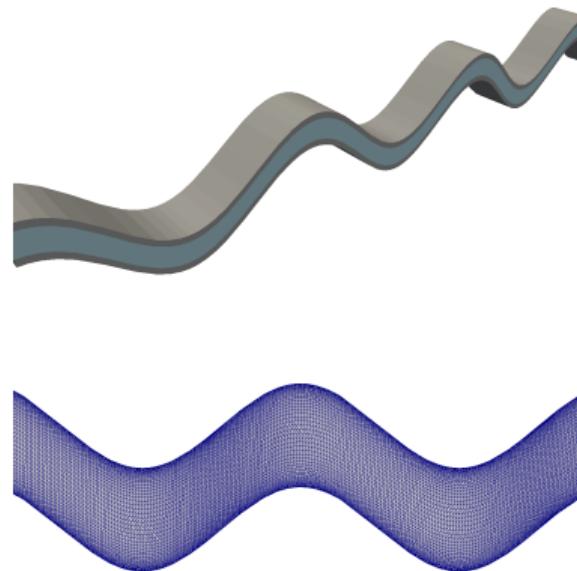
## HX Tube Simulation

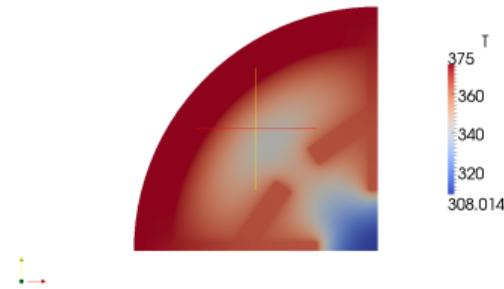
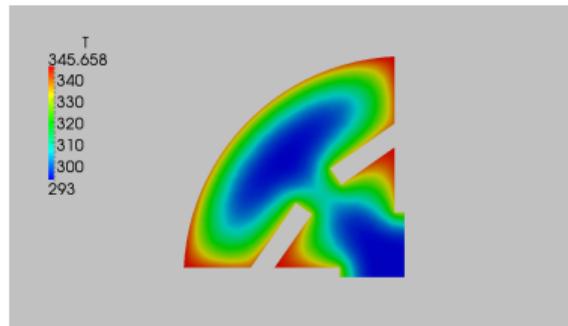
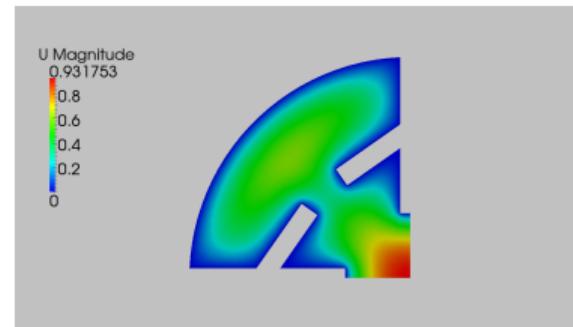
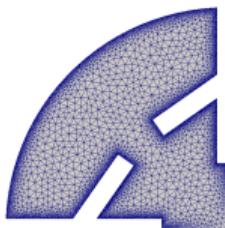
Undertaken by David Tranter; funded by Innovation Voucher

Undertook CHT simulations on individual tube designs (varying geometries provided by HiETA).

Validated modelling based on pressure drop, friction factor

Investigated heat transfer, range of Re, varying designs.





## Other Work

Current work with Pedro Lopez (PhD Student, U.Coimbra, Portugal + Dr Jorge Leandro)

“Numerical and experimental study of the free surface behaviour under the effect of turbulence on flood control devices”

Currently studying entrainment modelling – similar mathematics to phase change

# Work Programme

Tasks to undertake – Exeter :

- Advertise for + recruit PDRA for project
- Small scale HX simulation – extend David Tranter's work
- Identify + implement phase transfer model
- Develop multiscale model

In parallel :

- KTP project – multiscale modelling, optimisation
- 3rd year UG projects (particularly experimental)