# Open Call: Post-doctoral Research Assistant at Swansea University

## Project description

The project entitled “Reduced order modelling for characterising oil reservoirs” is funded by Chevron Corporation.

The current role of finite element analysis in Chevron Corporation is limited by the complexity of the simulations that are required and the number of parameters involved in each simulation, in many cases containing a certain level of uncertainty.

This project aims at developing reduced order models based on the proper orthogonal decomposition (POD) and the proper generalised decomposition methods (PGD) to obtain parametric solutions to analyse and predict the effects of varying scalar fields (material properties, pore pressure and boundary conditions) on the response of a finite-element based Mechanical Earth Model (MEM).

**Year 1** will involve the implementation and testing within an implicit finite-element solver provided by Swansea University. The aim of this testing phase is to prove that ROM techniques can be used to predict the behaviour of the solution (in terms of stresses, strains and displacements) upon changes of the scalar variables, allowing the quantification that uncertainty of such variables would have on the model results. To be considered valid, the test should demonstrate that the technique(s) can be applied on large (> 10 M elements) finite-element models and that will be significantly more efficient than conventional “design of experiment” or Montecarlo-based approaches.

If the activity of year 1 is considered successful by Chevron Corporation, **year 2** will involve a collaboration with Three Cliffs Geomechanical Analysis Ltd. to implement the ROM technique(s) tested in Year 1 into the implicit version of ParaGeo. In parallel, a reduced order model will be developed to handle geometric parameters. This sub-task will also aim at understanding how drastic these geometric changes could be, and if ROM techniques can be used to quantify the effect of geometric uncertainty in MEMs.

If the activity of year 2 is considered successful by Chevron Corporation, **year 3** will involve implementing the developed ROM for geometric parameters in the software provided by Three Cliffs Geomechanical Analysis Ltd. It is anticipated that this stage will require the appointed post-doctoral RA to collaborate with another post-doctoral RA that will be employed to develop meshing tools for Chevron Corporation.

## Specific responsibilities

- Develop and implement a reduced order model to obtain parametric solutions to analyse and predict the effects of varying scalar fields on the response of a finite-element based Mechanical Earth Model.
- Extend the formulation to geometric parameters.
- Implement the reduced order models within the software provided by Three Cliffs Geomechanical Analysis Ltd.
Funding and Eligibility

**Salary:** £30,046 to £33,797 per annum, together with USS pension benefits.

**Contract:** Fixed term (1 year that will can be extended to 3 subject to a positive evaluation of the results on a yearly basis).

**Essential criteria**
1. A Degree in Mathematics, Engineering, Computer Science or related subject.
2. Evidence of the ability to actively engage in and contribute to writing and publishing research papers, particularly for refereed journals.
3. A demonstrable ability to conduct research in line with the objectives of the project
4. Evidence of planning skills to contribute to the research project.
5. A high level of programming ability and experience in developing finite element software.
6. A commitment to continuous professional development

**Desirable Criteria**
1. A PhD in Applied Mathematics, Engineering or Computer Science (or near completion).
2. Evidence of knowledge of reduced order modelling (POD and PGD), including its implementation.
3. Track record of publications in refereed journals.
4. Track record of participating in international conferences.
5. Evidence of commitment to Continuing Professional Development.

**Research team**

The appointed research assistant will work on the prestigious Zienkiewicz Centre for Computational Engineering, acknowledged internationally as the leading UK centre for computational engineering research. Our pioneering of the Finite Element Method is recognised as one of the top 100 discoveries and developments in UK universities to have changed the world.

The person appointed will join a team of world experts in computational engineering with a long-standing experience of delivering industrial impact. Early research on the application of unstructured mesh methods in aerodynamics was undertaken with the support of NASA Langley Research Centre, BAE Systems and DRA. More recently the team has been involved in H2020 projects to develop reduced order models, with partners such as Volkswagen and SEAT.

**Contact and application**

**Informal enquiries**
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**Application**
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