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| **Project Name:** | Dynamic semi-structured meshes for fast numerical simulation of Multi-Phase Modelling in Energy Industry |
| **Project Reference:** | ICAM62 |
| **Principal Investigator:** | Prof Christopher Pain |
| **Co- Investigators:** | Dr Pablo Salinas |
| **bp-Mentor(s):** | Dr Andre Nicolle |
| **Fundamental/Applied:** | Fundamental |
| **Research Personnel:** | Amin Nadimy |
| **Project Start date:** | Oct 2020 |
| **Project End Date** | Oct 2024 |

**Quarterly Progress- Q2-2021 [30st June 2021]:**

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| **Attendees:-**  **Prof. Christopher Pain and Dr Pablo Salinas and Amin Nadim**  **Progress:-**  *No more than 1 page - Include highlights on research, personnel etc. and any issues/risks to delivery.*   * This report covers the end of March 2021 until 30 June 2021. * Fundamentals of the mathematics behind discontinuous Galerkin in the Finite Element method was studied. The focus was on 2-dimensional problems. The test problem was the transport equation in 2D. * The low order of the problem (P0) was first implemented in Python and then in Fortran. Then, moved to a higher order of the problem (P1) and the Fortran code was developed. * The Fortran code was optimised and was made more general to be able to move to even higher-order problem with no issue. Some extra features such as direct and indirect solver were added to the code. * At the end the Petrov-Galerkin method was applied to the previous sections to stabilise the results. * Al onside the above sections, the student modified the IC-FERST code to work on the collapsing water column problem. The aim was to implement the barycenter method and increase the resolution of the problem which was the initial part of the semi-structured meshing. This was stopped to put the focus on the Fortran code and will resume in the third quarter. * The student also worked on the data storage method for the structured part of the mesh. Single array storage is proposed with 2 formula which gives the neighbouring element data for P0 and P1 problems. * The student also attended 4 extra courses: 1- ESE Values 2- Unconscious bias 3- Equality and diversity 4- Bullying and Harassment. |
| **Health and Safety:** *This is in relation to your bp ICAM project and local laboratories - Please report by university. No. more than 4-5 lines – please provide a brief explanation of Health and Safety activity within the quarter as summarised above (include also Health and Safety training, Health and Safety improvements made), including numerical data on:*  **N/A**  **Total no. of safe acts/conditions observed in quarter:-0**  **Total no. of accidents/incidents reported in quarter:- 0**  **Total no. of local lab walkthroughs in quarter:- 0**  **Health and Safety Notes:**  The work involves literature evaluation and theoretical computer simulation so there are no inherent HSE issues beyond the common risks of ergonomics for prolonged computer use. |

**MILESTONES:**

**Blue - 'complete'; Green - 'on-track', Yellow - 'concern but doable', Red - in trouble or overdue; Purple - 'Reprioritised'**

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| **MILESTONE** | **TARGET DATE** | **STATUS** | **COMMENTS** |
| **Proposing data structure for semi-structured meshes.** |  |  |  |
| **Adding the Barycentre option to IC-FERST** |  |  |  |
| **Developing Fortran code for P0 DG-FEM** |  |  |  |
| **Developing P1 DG-FEM in Fortran and generalising the code** |  |  |  |
| **Debugging and generalising the code** |  |  |  |
| **Applying a stabilise method (Petrov-Galerkin) to the Fortran code** |  |  |  |
| **Preparing the early assessment report** |  |  |  |
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