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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.*   * Fundamentals of the mathematics behind the discontinuous Galerkin method in Finite Element was studied, focusing on 2-dimensional problems and the transport equation. * A low order discretisation (P0) was implemented in Python and then in Fortran. Next, a higher-order discretisation (P1) was developed and implemented in Fortran. * The Fortran code was optimised and was generalised to be able to deal with even higher order discretisation (P2) and type of elements (triangles). Moreover, direct and iterative solvers were included. * To ensure the stability of high-order discretisation a Petrov-Galerkin method was implemented to ensure such stability. * A data structure suitable for the semi-structured nature of the project was developed and implemented. Single array storage is used for P1-DG and two arrays for P0, splitting between up and down triangles. In all the cases a corresponding formula to access neighbouring elements has been developed. * The student also attended 4 extra courses held by the graduate school: 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.** |  |  |  |
| **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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