Project Title:	Computational Modelling of Multiphase Flow in Coastal and Deep Sea Reservoirs
Project Number	**IMURA0607**

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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1. <mark>Advanced computational engineering, simulation and manufacture</mark>
2. Infrastructure Engineering
3. Clean Energy
4. <mark>Water</mark>
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

This research problem deals with multiphase flow through naturally fractured hydrocarbon reservoirs in coastal and deep sea regions. The non-renewable petroleum resources on the land have been over exploited and getting depleted. The explorers are now moving towards coastal and deep sea regions to explore possible oil and natural gas reserve. Efficient exploration and management of such petroleum reservoirs requires a detailed understanding of the complex flow conditions. Due to unavailability of direct analytical solution to study complex multiphase flow problem in naturally fractured hydrocarbon reservoirs, numerical models are required to be used for solving these problems. This research work aims to develop a numerical model for simulating multiphase flow through fractured porous media.

Project aims

The main aim of the proposed project is to develop a numerical model to simulate the multiphase flow through fractured porous media in the coastal and deep sea reservoirs. The objectives of research are:

1. To do exhaustive literature review for understanding the mechanisms of flow through fractured porous media particularly accounting for advances in computing over last decade.

2. To develop computational model of multiphase flow through fractured porous media.

3. To extend the above model and develop separate models for flow through coastal and deep sea reservoirs.

4. To calibrate and validate the proposed models.

5. To demonstrate the application of developed models by carrying out experiments and applying to a real field case study problem from literatures.

Expected outcomes

The problems associated with the multiphase flow in naturally fractured hydrocarbon reservoirs are very complex in nature. A numerical model will be developed. Laboratory scale experiments will be carried out for a typical flow through fractured media. This data will be useful in calibration of the numerical model. The model will then be validated with established field studies. The validated model can be used to analyse the problems and to propose alternatives strategies for multiphase flow in petroleum reservoirs for better quantification/flow budget purposes. The proposed research will help petroleum industries to make a decision in evaluating various alternative strategies in the case of fractured hydrocarbon reservoirs or various possible combination of fractured reservoirs and porous reservoirs for better yield. Multiphase flow in fractured reservoirs will be highly useful in other research areas such as enhanced oil and gas recovery, isolation of radioactive waste, exploration of geothermal fields for generating power supply, co_2 sequestration, coal seam bed methane recovery, reservoir exploitation for water supply and geotechnical applications (including effects on underground storage reservoirs, tunnels and other structures), etc.

How will the project address the Goals of the above Themes?

The project involves numerical solution of isotropic/anisotropic multiphase flow and transport partial differential equations and hence requires high-end computation. Simulations are targeted towards improved understanding of flow and transport through fractured porous media hydrocarbon reservoirs. The model, once calibrated and validated would be used to provide possible profile of multiphase flow in the real field scale problem. Hence, the present project will address the goals of both the themes highlighted above.

Capabilities and Degrees Required

Persons with the following qualification should be considered eligible:
B.Tech/M.Tech degree in Civil, Environmental, Water Resources engineering and petroleum engineering.

Capabilities: An ideal candidate will have a strong interest in computational studies of multiphase flow

through fractured porous media. The candidate with some experience and interest in basic computer programming languages (Fortran/C/C++/MATLAB) will be preferred.

If the candidate has studied any of these following subjects Numerical methods particularly FEM, Advanced Fluid Mechanics, Environmental system modelling and Rock mechanics are highly preferable.

Potential Collaborators

Oil and Natural Gas Corporations, Central and State Ground Water Boards, Petroleum Corporations

Please provide a few key words relating to this project to make it easier for the students to apply.

Multiphase Flow Modelling; Coastal and Deep Sea Reservoirs; Naturally fractured hydrocarbon reservoirs; Fractured porous media flow.