Newton Fund - Sustainable Gas Futures Workshop (SGF) 25th-27th February 2015

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Affiliation: Aeronautics Institute of Technology (ITA- Instituto Tecnológico de Aeronáutica)
Position: Full Professor of ME, Head of Department of Energy IEM-E, Head of Cooperation Division (International & National) IEX-C, Head of Computational Transport Phenomena Laboratory – LCFT/ITA
Interests: Computational Thermo-fluid Dynamics, Transport Phenomena, Porous Media, Advanced Fossil & Renewable Energy Systems, High Performance Computing, Turbulent Reactive Flow, Computational Mathematics, Combustion Dynamics, Modelling And Simulation of Heterogeneous Systems, Fuel Cells, Gasification Processes and CO_2 Capture Technologies.

- A word about ITA
- Research Activities at LCFT/ITA
- Digital Rock Modeling & Simulation – Smart Water

- COMPUTATIONAL TRANSPORT PHENOMENA LABORATORY – LCFT/ITA

ITA - The beginning: professors from more than 12 countries

First students arrival in
May 1950

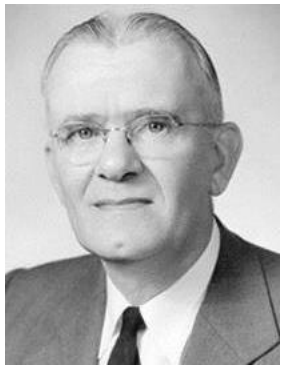
Educational model from the
MIT - 1947

ITA was founded in the 1950s with strong participation of American and European professors. The first four ITA presidents were American professors. The first one was Prof. Richard Smith from MIT

First ITA Presidents/Rectors

Prof. Smith
1946-1951

Prof. Joseph Morgan Stokes
1951-1953



Prof. Johannes Meyer
1953-1956

Prof. Samuel Steinberg
1956-1960

Prof. Marco Antonio Cecchini
(1960-1965)
1st Brazilian Rector

Instituto Tecnológico de Aeronáutica – ITA

ITA provided the conditions for establishment of EMBRAER (Brazilian Aircraft Company) in the late 1960's.

Over the last three decades, EMBRAER has become the 3rd largest Commercial Aircraft Manufacturer (*mid-size 100-seat aircrafts, after Boeing, Airbus and surpassing Bombardier!*).

ITA was conceived to support a "future" Aeronautical Industry in Brazil, but today R&D work has been extended to other research areas.

Instituto Tecnológico de Aeronáutica – ITA

600 undergraduates students
1200 graduate students

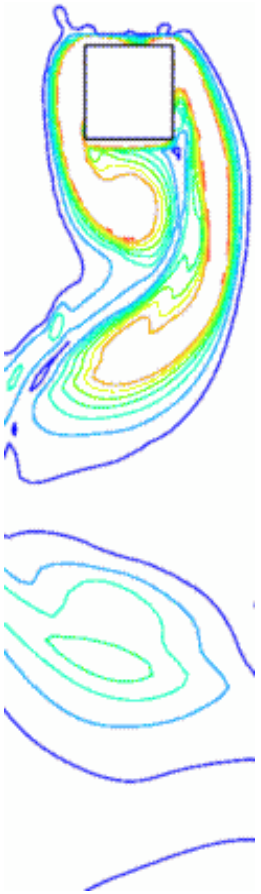
Engineering School:

- ✓ Aeronautical Engineering
- ✓ Aerospace Engineering
- ✓ Civil Engineering
- ✓ Computer Engineering
- ✓ Electronics Engineering
- ✓ Mechanical Engineering

Course duration:
5-year - Bachelor's of Engineering

LCFT - ITA

- Linked to the Department of Energy of the Mechanical Engineering Division of ITA.
- Activities started in 1995.
- Established on October 19th, 1999.
- Mission Statement: "*Support computational activities needed for R&D projects involving the numerical solution of flow, heat and mass transfer problems*."

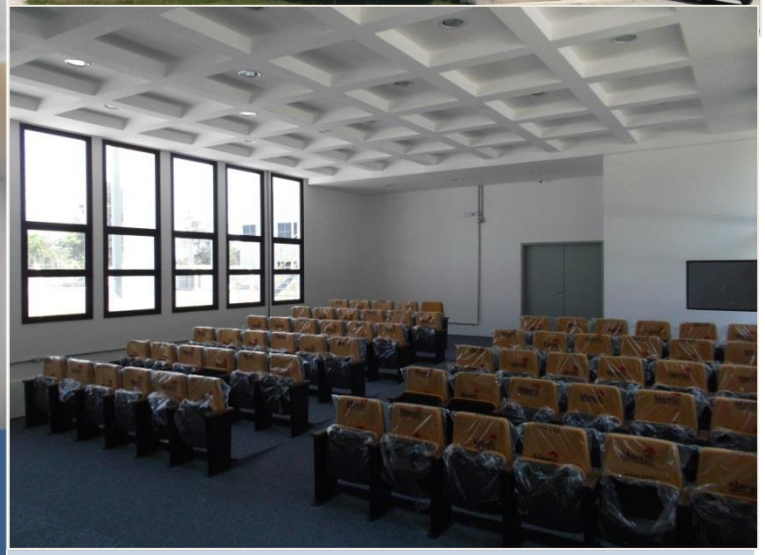


FAPESP

Newton Fund

50 NERC SCIENCE OF THE ENVIRONMENT

COMPETENCE CENTER FOR ENERGY - CCE/ITA *energia@ita.br*



The best School of Aeronautical Engineering in Brazil is also an excellence center in Energy Research: Renewable (Solar, Wind, Biomass), Oil & Gas, Fuel Cells, Hydrogen. E-mail: energia@ita.br

BR PETROBRAS CNPq ITA

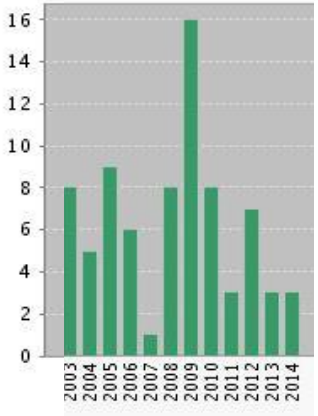
CAPES FUNDEP ITAG FAPESP FAEPEG

Research Group at LCFT/ITA

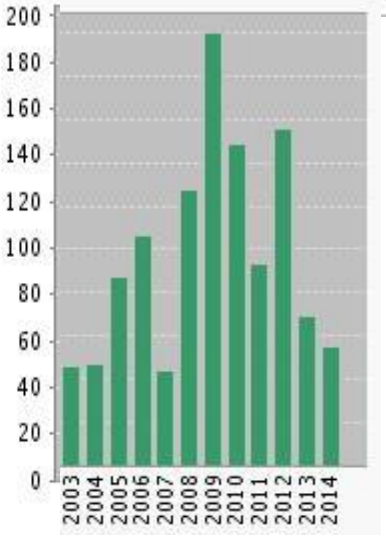
- Scientific Production: Papers, *http:/lcft.mec.ita.br/articles*

ISI Web of Knowledge℠

Published Items in Each Year

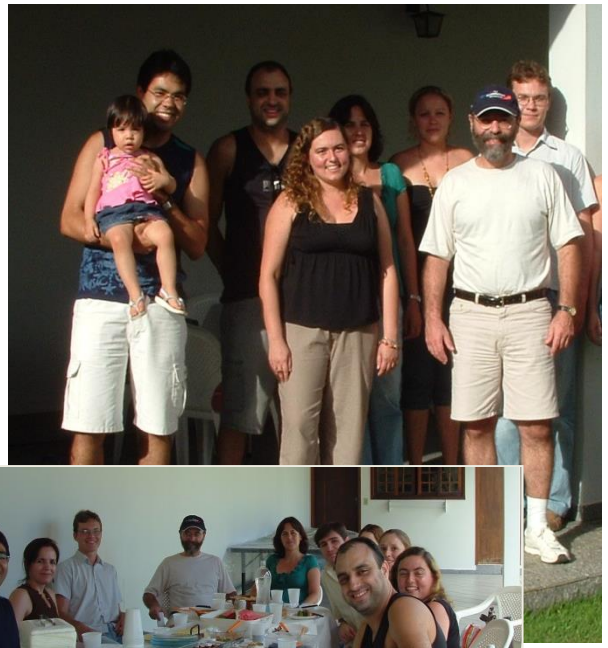


Citations in Each Year



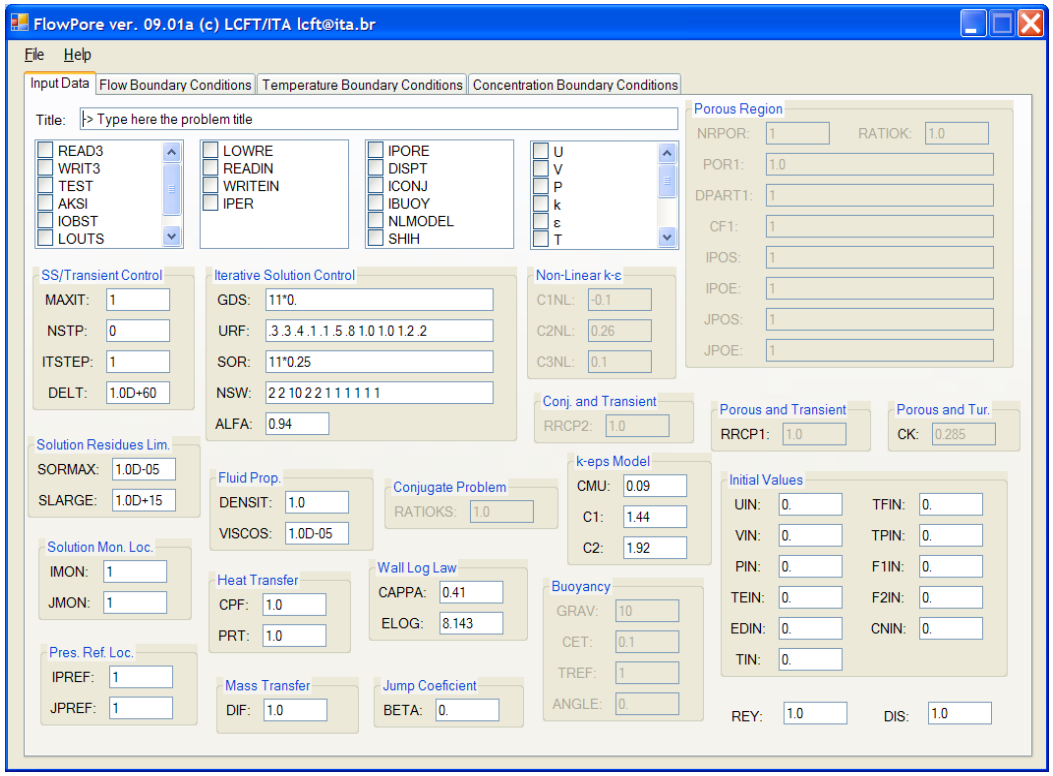
- Books: *Elsevier, Springer, Wiley-VCH*

- Research Team at leisure time: MSc & PhD Students, Post-Doc. Visitors



In-house & Open CFD Software Development – MSc and DSc Theses

FlowPore



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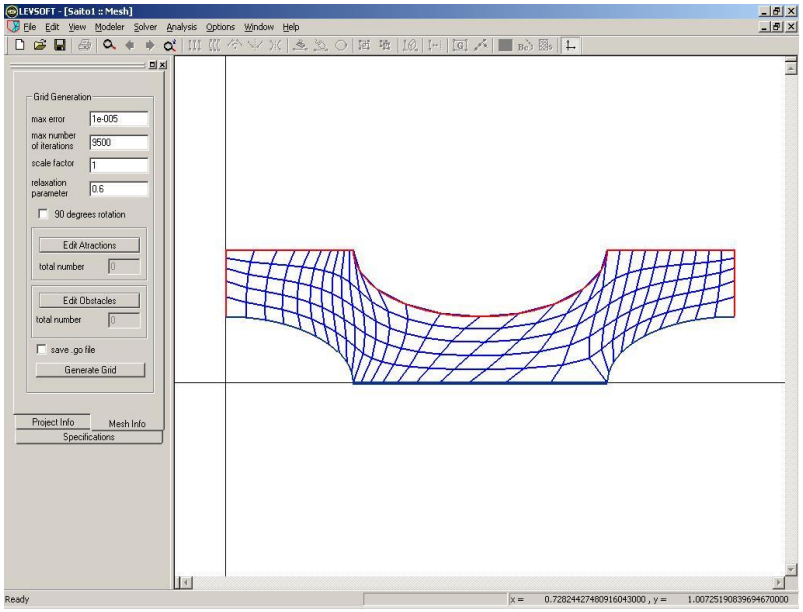
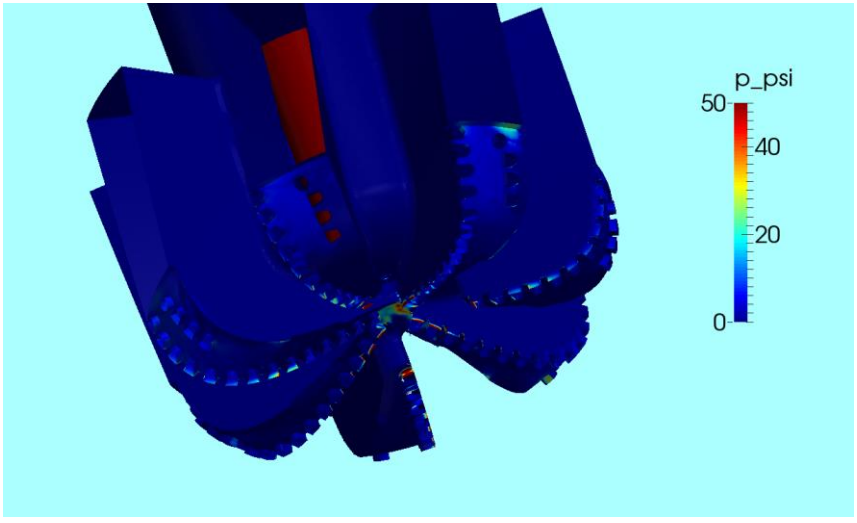


OpenFOAM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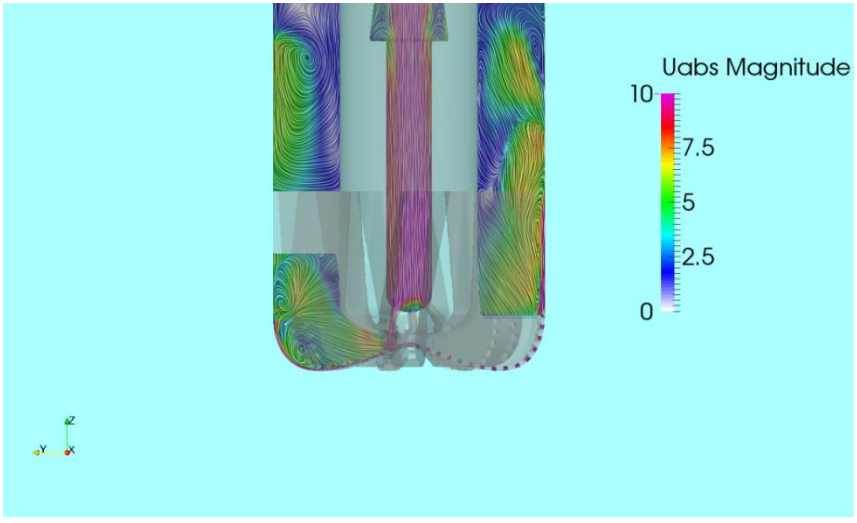
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2.5
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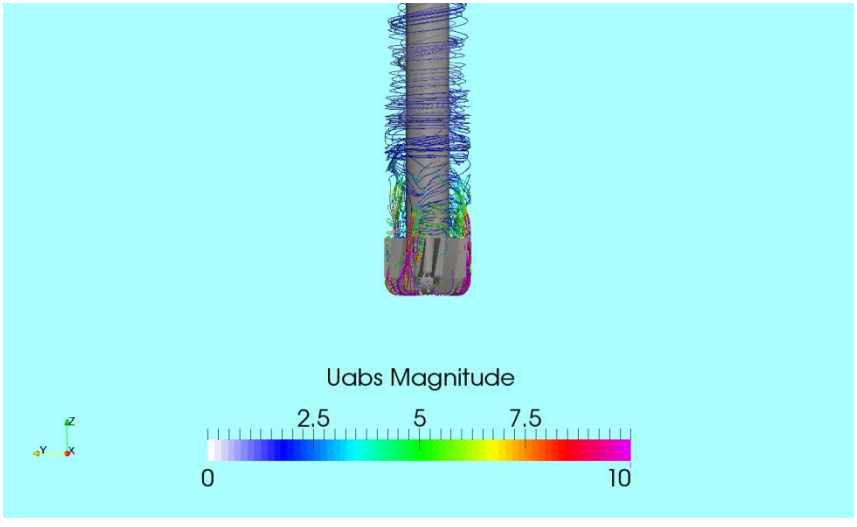
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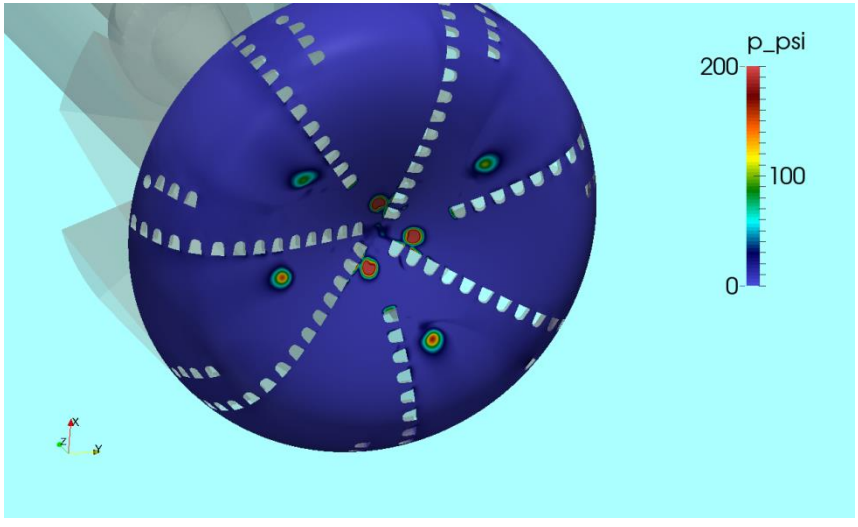
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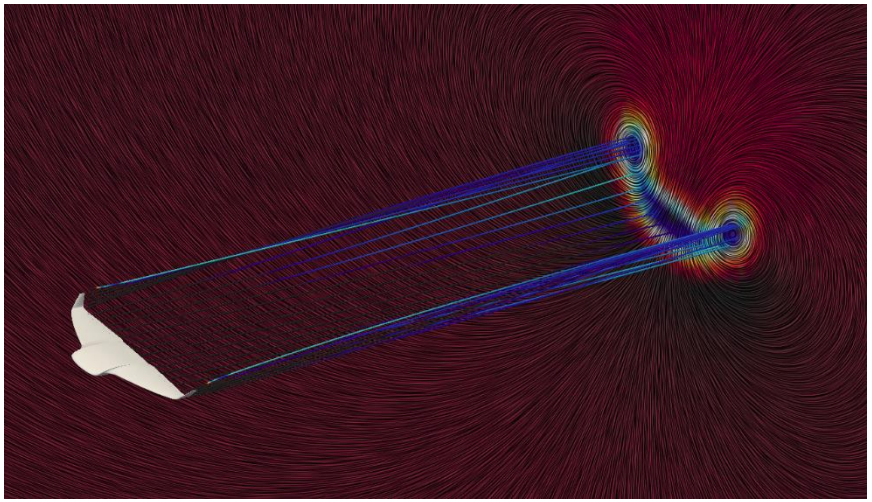
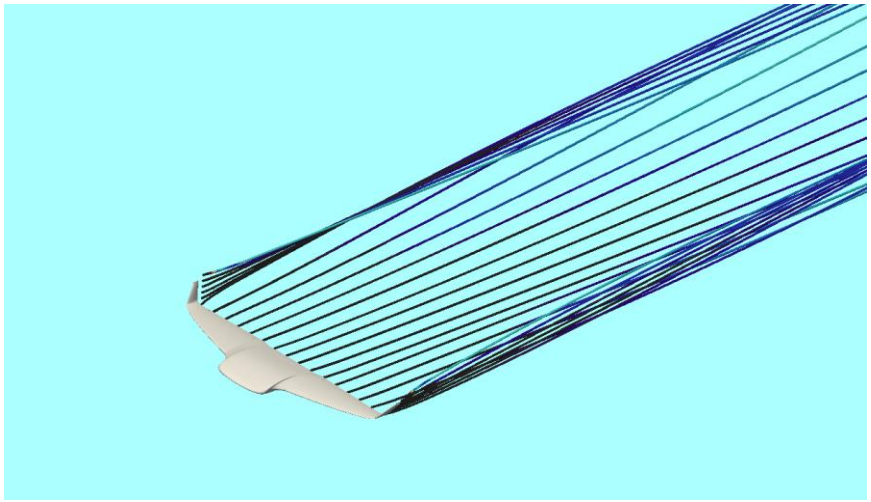
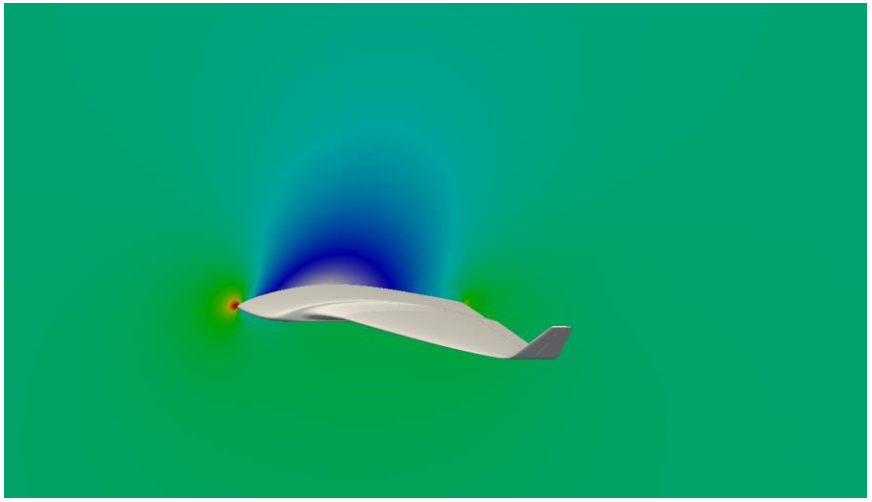
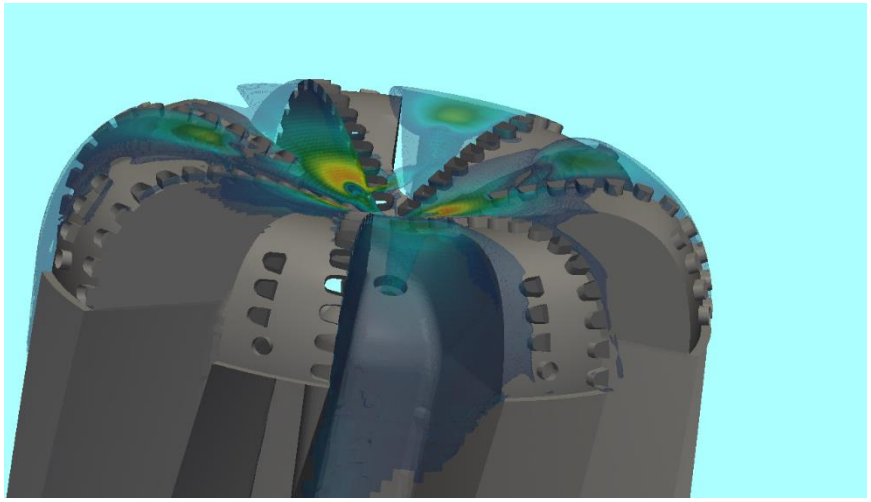






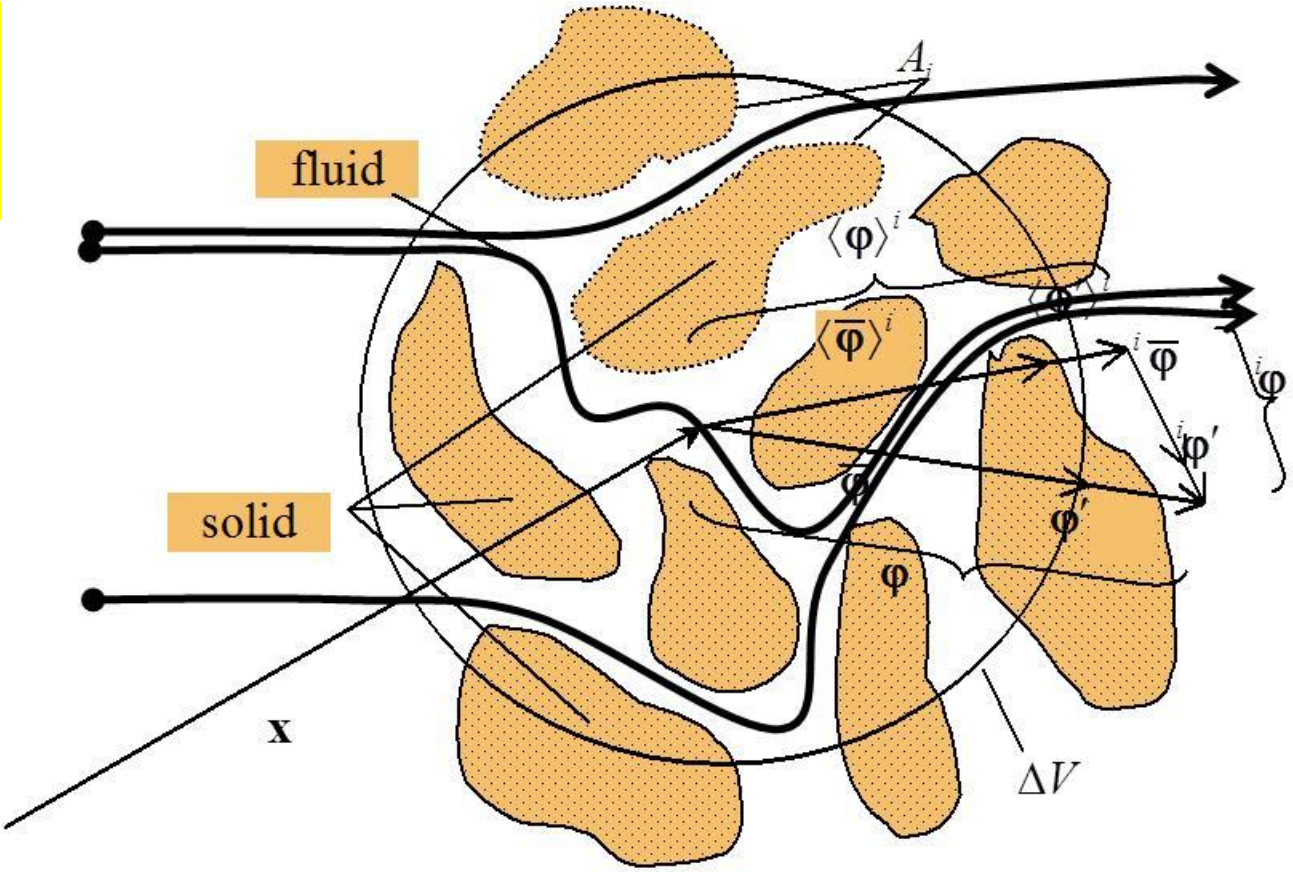


Modeling of Heterogeneous/Multiphase Systems

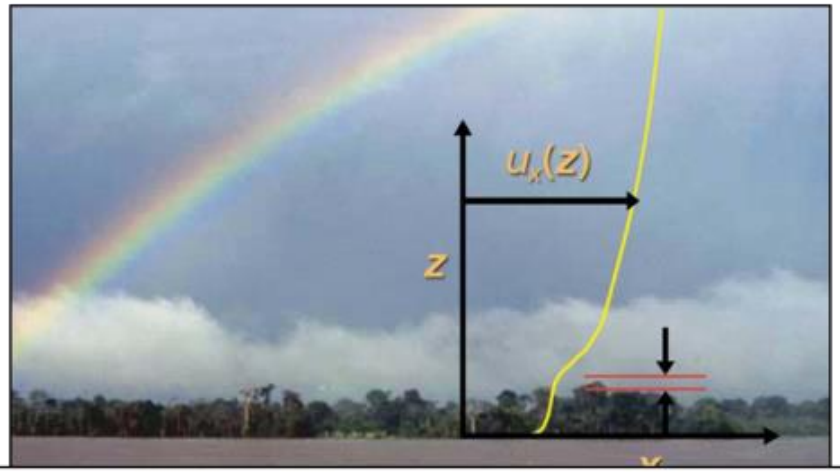
$$\langle \varphi \rangle^{v} = \frac{1}{\Delta V} \int_{\Delta V} \varphi \, dV$$

$$\phi = \frac{\Delta V_f}{\Delta V}$$

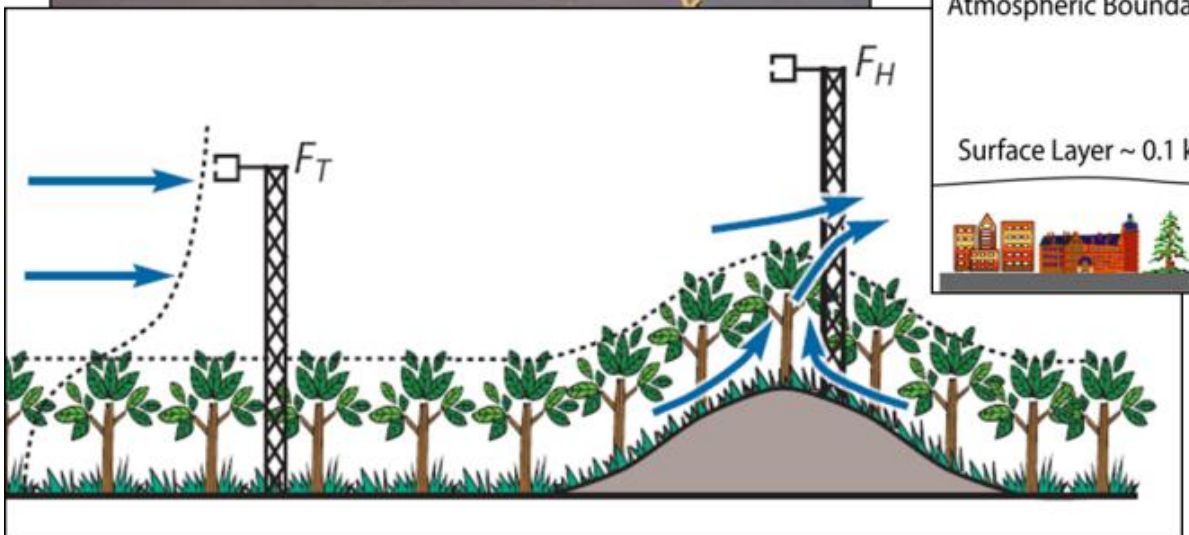
$$\mathrm{Re}_p$$

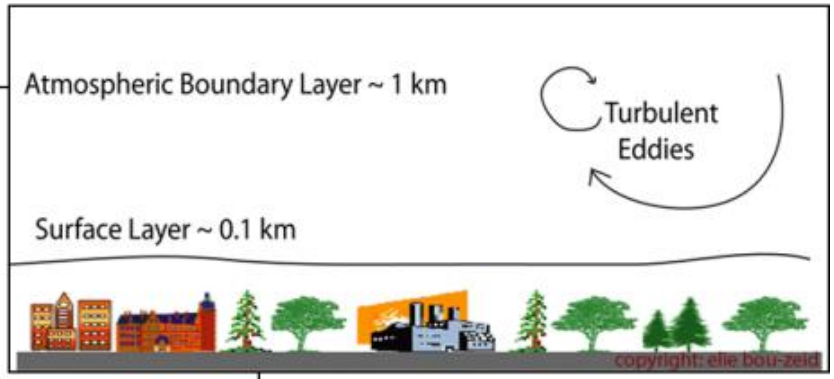


Applications - I



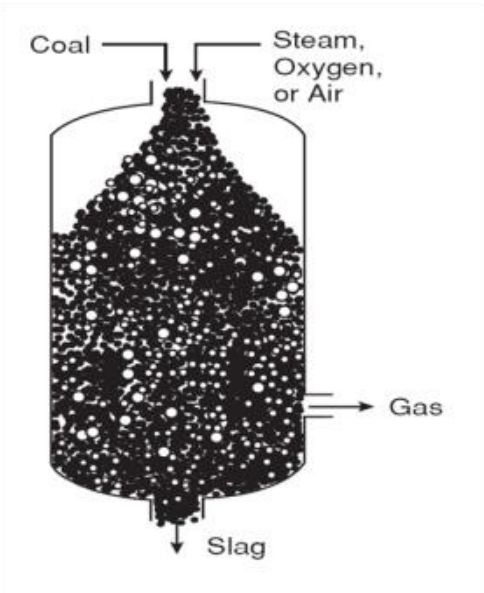
Environmental Flows: Atmospheric BL over Forests, Plantations, Cities, etc.

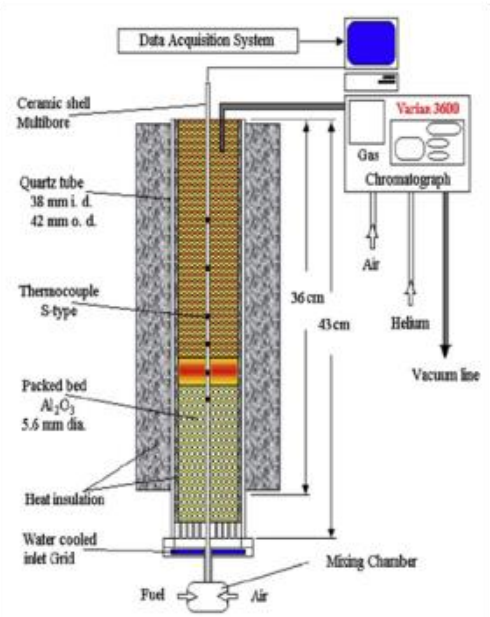




Applications - II

Engineering Flows: Gasifiers (Biomass, Coal), DRI (Direct Reduced Iron) Equipment, Porous Burners, Hydrogen Production Reactors, Moving Beds, Heat Exchangers, Nuclear Reactor Core





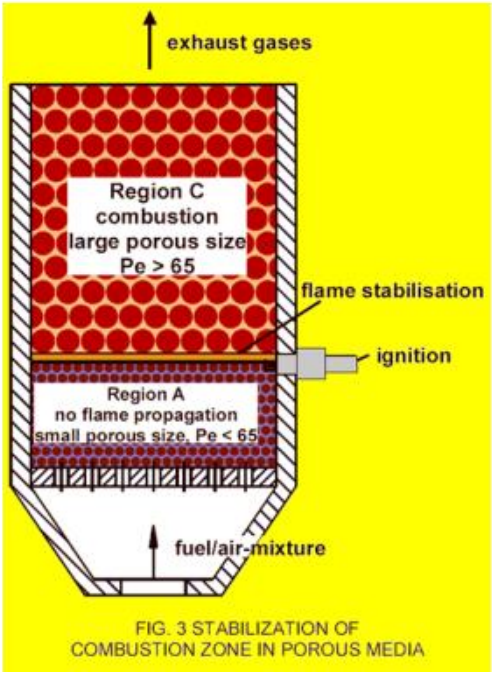


FIG. 3 STABILIZATION OF COMBUSTION ZONE IN POROUS MEDIA

Smart Water Flooding for Brazilian deep offshore reservoirs

ITA & University of Aberdeen (UoA)

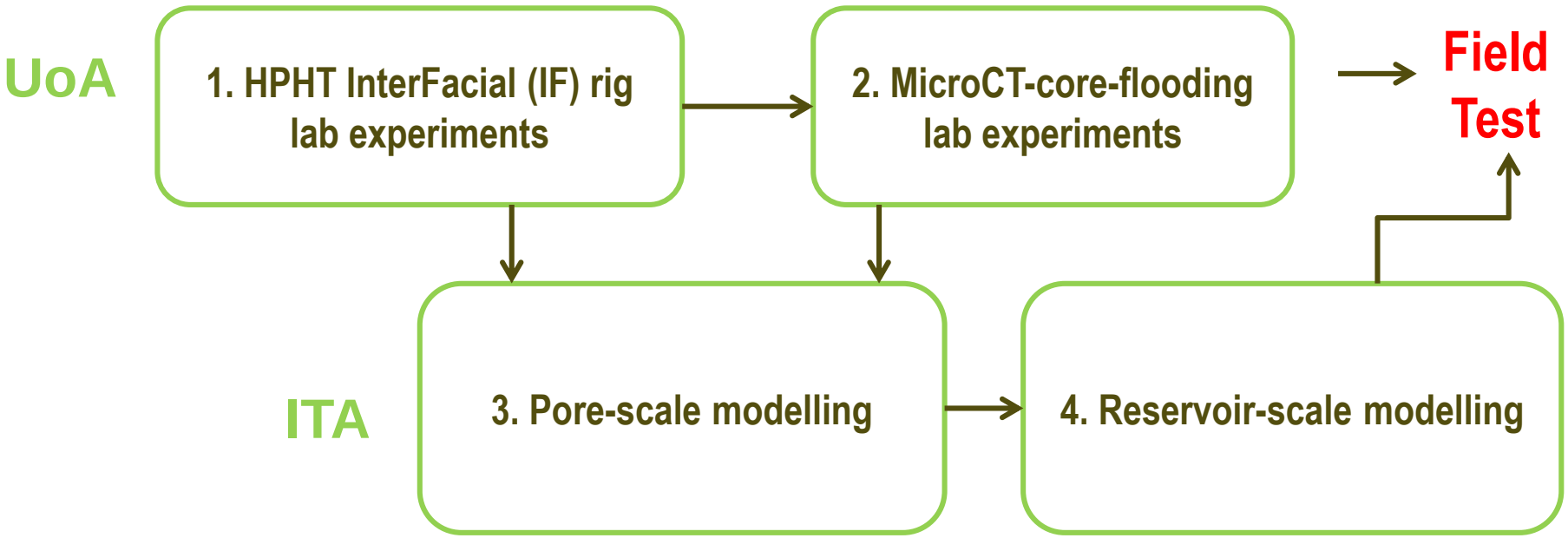
Prof. Marcelo de Lemos, ITA
Prof. Dubravka Pokrajac, University of Aberdeen
Dr David Vega-Maza, University of Aberdeen

- **Experimental facilities**
  - **HPHT InterFacial Rig – $200,000**
  - **XRadia MicroCT scanner – $1,000,000**
  - **Both facilities are funded by the Scottish Government.**
- **Staff**
  - **Dubravka Pokrajac - over 20 years experience in experimental and numerical investigation of multi-phase flows in reservoirs**
  - **David Vega-Maza - thermo-physical properties of fluids at HPHT corrosive conditions**

Project Aim

Use Smart Water flooding to **minimise amount of produced water** and **maximise amount of recovered oil** by tuning-in of the capillary pressure which depends on the water-oil inter-facial tension (IFT) and the wettability of the reservoir rock.
Smart Water flooding increases mobility of oil by decreasing the forces which hold the oil attached to the rock matrix

Project Objectives



Thank you!