

# EFFICIENT COMPUTATIONAL STRATEGIES FOR COMPLEX COUPLED FLOW, THERMAL AND STRUCTURAL PHENOMENA IN PARAMETRIZED SETTINGS

Simulation Databases Business processes  
Data mining Photovoltaic Choice  
Strategy Industrial processes Solar  
Exploitation of internal information Bioestadística Optimization  
Quality control Logistics Modelling Software  
Market studies Business intelligence  
Pollutants Renewables  
Dispersion Propagation Planning  
Analysis of customers

## PRINCIPAL INVESTIGATOR:

- Prof. Peregrina Quintela Estévez (ITMATI, ES)
- Prof. Gianluigi Rozza (SISSA, IT)
- Ing. Gianfranco Marconi (Danieli Officine Meccaniche, IT)

## EARLY STAGE RESEARCHER:

ESR08

## HOST INSTITUTION:

ITMATI, ES

## SECONDMENT INSTITUTION:

- Danieli Officine Meccaniche- IT
- SISSA- IT

## PLANNED SECONDMENT:

50% of the time at Danieli, in the form of 6-months stays, possibly combined

## LENGTH:

36 months

## Project Description:

Present and future efforts in simulation-based sciences are dedicated to hierarchies of complex multi-physics problems, as well as parameterized systems characterized by multiple spatial and temporal scales. New ROM methodologies are required for coupled and parameterized problems in industrial and medical sciences. This concerns in particular fluid-structure interactions and thermo-fluid-dynamics and the use of these reduced models for Fluid-thermal phenomena.

**Objective** of this research project are the numerical simulation of the evolution of the fluid using a turbulence and multi-phase model. A transport passive scalar phenomenon will also be modelled in the problem. Moreover, modelling and simulation of 3D thermal-fluid-structure phenomena will be developed. Numerical simulation will be performed on free or commercial software packages of proven quality. The objectives of the research also include reduced order modelling (computational, geometrical and parametric) for hierarchies of coupled multi-physics problems and the construction of test cases as well as carrying out numerical experiments.

## Description of academic partner:

The **Instituto Tecnológico de Matemática Industrial (ITMATI)** is a public consortium of the three Galician universities (A Coruña, Santiago de Compostela and Vigo). ITMATI provides advanced solutions for productive sectors in three main transfer areas: Numerical Simulation, Statistics and Big Data and Optimization. Its main goal is to enhance the mathematical to companies in order to improve competitiveness and support innovation. ITMATI has a staff made up of 26 highly qualified professionals, 19 of whom are researchers. In addition, ITMATI has 39 affiliated researchers with extensive and recognized expertise, selected from the 3 Galician universities.

**SISSA**, the **International School for Advanced Studies**, was founded in 1978 and is a scientific center of excellence within the national and international academic scene. It features 70 professors, about 130 post-docs, 250 PhD students and 95 technical administrative staff. The three main research areas of SISSA are Physics, Neuroscience and Mathematics. All the scientific work carried out by SISSA researchers is published regularly in leading international journals with a high impact factor, and frequently in the most prestigious scientific journals such as Nature and Science. The School has also drawn up over 280 collaboration agreements with the world's leading schools and research institutes.

## Portfolio of Industry Partner:

**Danieli** is one of the largest suppliers of plants and processes for the metal industry. Danieli develops technologies and it can supply equipment and complete plants (turnkey projects). An international multicultural team that covers the full spectrum of technology from iron ore to the different finished products. It introduced to the market the highest number of innovations recent years, investing an average of 140 M Euro/Year in the last eight years. Its extensive, in-house manufacturing capability ensures equipment of the highest quality and reliability, thanks to continuous process control, as well as ensuring multicultural intellectual growth, taking advantage of different cultures and motivations. Software algorithm models, computerized quality and production control systems, adopting the most advanced information technologies like fuzzy logic, neural systems, modeling, and simulation are developed in-house and this results in a Danieli process know-how transfer to final users.



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