MATHEMATICAL SCIENCES

PNRR - Advanced parallel numerical methods for model driven and data driven large scale complex physical models

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	BERRONE STEFANO - stefano.berrone@polito.it
Contact	CANUTO CLAUDIO - claudio.canuto@polito.it BERRONE STEFANO - stefano.berrone@polito.it
Context of the research activity	The project aims to develop advanced parallel numerical methods for solving large-scale complex physical models, both model-driven and data-driven. The methods will be designed to take advantage of parallel computing architectures and optimize performance, accuracy and scalability. The project will explore various numerical techniques, including finite element methods and virtual element methods, and apply them to real-world problems in fields such as fluid dynamics, structural mechanics, and geophysics. Progetto finanziato nell'ambito del PNRR M4C2, Investimento 1.4 - Avviso n. 3138 del 16/12/2021 - CN00000013 National Centre for HPC, Big Data and Quantum Computing (HPC) - CUP E13C22000990001
Objectives	The aim of the research grant is the development of novel numerical methods for the solution of partial differential equations based on polygonal or polyhedral meshes, with particular regard to Virtual Element Methods (VEM). The research activity shall focus on the new research perspectives in VEM, for example with particular regard to stabilization-free VEM, exploiting the advantages of these innovative formulations in dealing with engineering problems for which standard VEM formulations display criticalities. The newly developed methods will be implemented in an efficient code and a parallel implementation suitable to exploit different parallel computer architectures will be investigated as well. The study will focus in particular on strongly anisotropic problems in thermo-fluid dynamics and non-linear solid mechanics problems, such as non-linear elasticity, elastoplasticity and contact problems. The coupling of differential problems in different dimensions (3D-2D, 2D-1D, and 3D-1D) will be investigated to tackle engineering problems in the field of hydrogeology,

	mechanics and environmental engineering.

Skills and competencies for the development of the activity	Numerical Methods for solving large-scale linear systems Numerical Methods for Partial Differential Equations Finite Element and Virtual Element Methods Good knowledge of Matlab and C++ language Basic knowledge of computer architectures