POLITECNICO DI MILANO

PhD in MODELLI E METODI MATEMATICI PER L'INGEGNERIA / MATHEMATICAL MODELS AND METHODS IN ENGINEERING - 40th cycle

PNRR 630 Research Field: CALCULATION TOOLS OPTIMIZATION FOR STEAM TURBINE PERFORMANCE PREDICTION

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	Global climate change is placing increasing emphasis on sustainable technologies using innovative fluids and materials. This fact has created new operating conditions that strongly impact the production of turbines, which must be designed on demand according to specific customer requirements; see, e.g., https://www.bakerhughes.com/ondemand-solutions. For this reason, manufacturing companies face a major problem of partial deficiency of the current state-of-the-art design, simulation, and verification codes in the operating regimes generated by the new conditions. These conditions impose the resolution of highly nonlinear and large-scale problems. In this scenario, the objective of the research subject of the proposed Ph.D. is to update existing methodologies currently employed and develop and implement new methods and physical models to obtain computational frameworks that are more efficient for standard operating conditions and robust to new ranges of applications.
Methods and techniques that will be developed and used to carry out the research	The simulation and optimization of turbines require efficient numerical frameworks robust against the different design requirements. For this reason, it is crucial to design novel iterative methods based on the most modern techniques of fixed point acceleration and extrapolation, nonlinear preconditioning, nonlinear elimination, and

	divide-and-conquer strategies, allowing highly parallelizable implementations. Moreover, the new operating conditions mentioned above require improving the used physical models. This can be achieved by exploiting the most modern techniques based on neural network approximation, where the training data will come from direct experiments and numerical simulations. The project will be carried out in collaboration with the company Baker-Huges (Nuovo Pignone – https://www.bakerhughes.com/baker-hughes-italia), which is a well-established developer and manufacturer of turbines, and thus is the most appropriate partner that can provide test cases for validating the new methodologies proposed in this project. A minimum 6-month internship at Baker-Huges and a 6-month research period abroad are planned.
Educational objectives	From the educational point of view the student will develop strong skills in mathematical modeling, optimization and design of steam turbine. In general the problem provides scientific challenges for a young researcher in applied mathematics and scientific computing.
Job opportunities	The research addresses innovative and advanced topics in Computational Modeling, Optimization and Applied Mathematics in general. Thanks to the large-view approach and the versatility of the applied methods, the exiting PhD student will surely be appreciated in the broad ensemble of research activities, both industrial and academic.
Composition of the research group	0 Full Professors 2 Associated Professors 0 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Edie Miglio, Prof. Gabriele Ciaramella

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	NUOVO PIGNONE TECNOLOGIE srl
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): financial aid per PhD student per year 1st year: max 2.038,16 euros 2nd year: max 2.038,16 euros 3rd year: max 2.038,16 euros The PhD students are encouraged to take part in activities related to teaching, within the limits allowed by the regulations.1 individual PC per student +several shared PC. Access to one cluster with 32 processors and 384 GB RAM, and to several multi - processor servers.