AEROSPACE ENGINEERING

DIMEAS - Machine learning and artificial intelligence to support aeronautical gas turbine design

Funded By	Dipartimento DIMEAS
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Context of the research activity	The research activity will be devoted to the development and application of data driven tools which can support the design of low pressure aeronautical gas turbines, with particular focus on aerodynamics. Machine learning techniques will be investigated to improve existing models with different degrees of fidelity which are applied during the design process. Artificial intelligence approaches will be discussed in order to evaluate their impact on the design process.
Objectives	The research activity will start from a detailed review of the literature to identify the most promising techniques which can introduce new benefits in the design process of aeronautical gas turbines. Machine learning techniques will be investigated to support different steps of the design process. First of all, surrogate models based on data-driven approaches will be considered. Starting from classical linear techniques in which a high-fidelity database is used to train a surrogate model in the offline phase, new approaches will be investigated, like for example non-linear interpolations or techniques based on different categories of neural networks. Particular attention will be also devoted to dimensionality reduction and identification of possible reduced spaces. Secondly, machine learning techniques will be investigated to improve the predictive capability of medium fidelity models, like Reynolds averaged Navier-Stokes (RANS) equations which are typically based on empirical closures. The reliability of RANS equations is limited in the presence of separation and transition phenomena: machine learning techniques will be investigated to augment RANS models with data-driven corrections which can circumvent these limitations. Particular attention will be payed to the development of data driven models which are physically consistent and interpretable. Finally, recent advances in artificial intelligence (AI), including generative AI, will be considered to evaluate their potential in supporting the design process.
Skills and competencies	A solid background in fluid dynamics and thermodynamics is required. The candidate should have a deep knowledge of the physical phenomena which

competencies for the development of the activity	influence the performance of gas turbines. Knowledge of the main algorithms used in Computational Fluid Dynamics (CFD) is required, as well as practical experience in running CFD simulations. A background in programming, statistics and data analysis is required.