ENERGETICS

Morfo Design/DENERG - Development of an innovative design environment for aerospace turbopump inducers

Funded By	Morfo Design srl [P.iva/CF:06861960489] Dipartimento DENERG
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Context of the research activity	The research activity deals with the development of high-performance components for turbopumps for space launch systems. The latter systems are strategic assets that underpin national security, economic growth, scientific advancement, technological innovation, geopolitical influence, and essential infrastructure services, making them critically important in today's world.
Objectives	Space turbopumps are indispensable for modern rocketry, contributing to the efficiency, performance, and reliability of space launch systems, and enabling ambitious space exploration and satellite deployment missions. Within space turbopumps, inducers are integral components, playing a crucial role in enhancing the performance of liquid propellant feed systems used in rocket engines. Inducers are designed to increase the pressure of the incoming liquid propellant, ensuring smooth and continuous flow into the main pump, thereby reducing the risk of cavitation. By improving the initial pressure conditions, inducers help maintain efficient and stable operation of the turbopump, which is essential for the reliable performance of rocket engines during space missions. The research activity will focus on the development of an innovative design environment for turbopump inducers for aerospace applications. This environment will make it possible to design inducers by simultaneously considering the structural aspects related to mechanical integrity, and the aerodynamic ones related to performance. Performance will include cavitation behavior, which is particularly relevant in aerospace turbopumps. The new design system will integrate inducer geometric parameterization, CFD calculation including an advanced cavitation model, and structural finite element analysis. By exploiting modern data analysis tools and techniques derived from artificial intelligence, the future design environment will allow the definition of innovative inducer geometries capable of maximizing aerodynamic performance while reducing cavitation problems and satisfying structural constraints. This will allow the designer to achieve solutions that are superior to the current ones and without requiring the typical iterations

	between the various disciplines, thus also reducing design time.

Skills and competencies for the development of the activity	The candidate should have a good basic understanding of aerospace turbopump inducers and of the cavitation problems associated with the use of liquid propellants. Also, a basic knowledge of computational fluid dynamics (with commercial tools, not necessarily in heat transfer analysis) is necessary.