Bio-Inspired Generative Design for Additive Manufacturing and Advanced Measurement Methods toward the Development of Sustainable Products with Integrated Functionalities: Tackling Biomedical and Industrial Challenges

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Abstract

The term "Additive Manufacturing" involves a range of technologies which add material, layer by layer, in order to form complex 3D structures. These technologies were formerly defined as rapid prototyping and today are commonly referred as 3D printing. Suitable CAD tools provide a support for the ideation process through the generation of several design alternatives.

It is also frequently reported how additive manufacturing technologies allow for the direct fabrication of smart and lightweight devices with specific external shape and architectural features as well as with tailored and improved structural/functional properties.

In this context, integrated design methods lead to product reimagination from a new standpoint, improving the performance of critical components in well-defined applications (e.g., biomedical, automotive, aerospace, and further industrial).

In particular, generative design for additive manufacturing represents an advanced strategy to design and develop innovative, sustainable, smart and lightweight products with tailored morphological, mechanical and functional properties, as well as with integrated functionalities.

Generative design is used to design complex shapes and optimized forms according to loading conditions, constraints, manufacturing options, cost, mass, environmental impact and other data that may influence the design. It will allow to explore all the solutions in order to find the best option. Artificial intelligence and machine learning will transform the design process into a sophisticated engineer-computer interaction.

The research will explore the design of 3D additive manufactured lightweight structures with suitable properties and integrated functionalities for different fields of applications. It would aim to expand far beyond the state-of-the-art and to develop novel technical solutions and approaches for a given engineering problem toward the design and manufacturing of next generation devices, in the form of 3D solid, cellular, lattice, functionally-graded or solid-lattice hybrid structures for biomedical and industrial applications, also enhancing the product development efficiency.

A bioinspired design for additive manufacturing may favour the development of innovative products based on the extraction of novel wisdoms.

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