From architectured materials to the development of large-scale additive manufacturing

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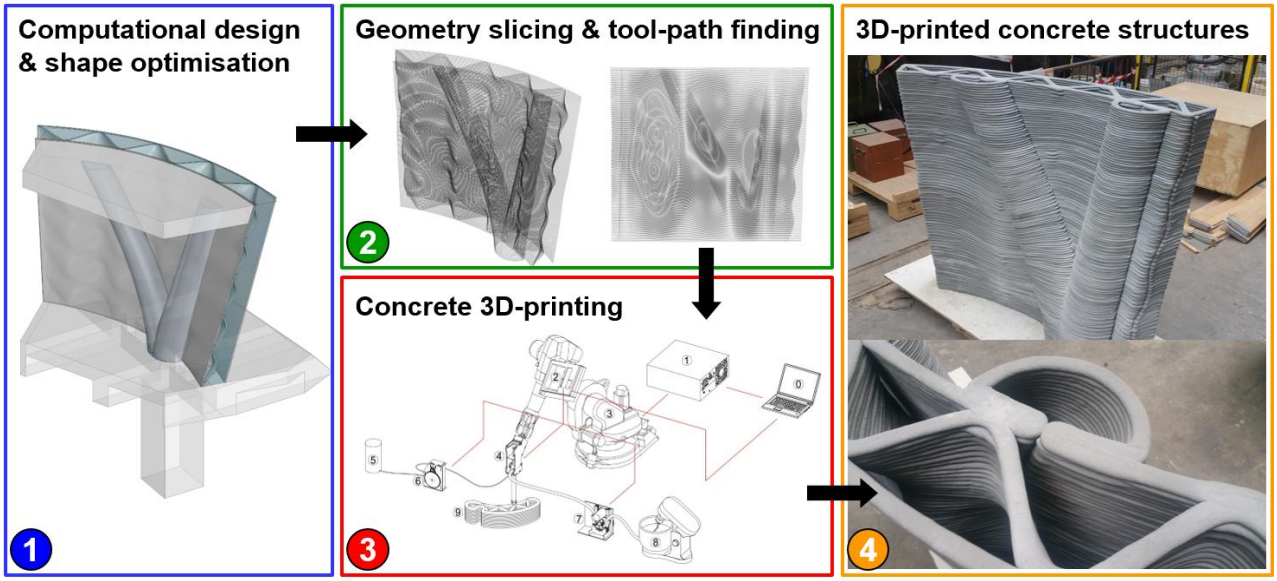
The classical engineering material-by-design approach has been extensively perfected by materials scientists, while engineers have been optimising structures geometrically for centuries. The purpose of architectured materials is to build bridges accross the microscale of materials and the macroscale of engineering structures, to put some geometry in the microstructure. This is a paradigm shift. Materials cannot be considered monolithic anymore. Any set of materials functions, even antagonistic ones, can be envisaged in the future. The development of architectured materials is involving materials scientists, metallurgists, chemists, physicists, mechanicians and engineers, but also biologists, computer scientists, architects, designers, mathematicians, etc. In this presentation, we intend to demonstrate the necessity of computation for developing architectured materials, and the incidental outcome which led us to developing large-scale additive manufacturing for architectural applications.



Justin Dirrenberger is a materials scientist and associate professor of metallurgy at CNAM in Paris. In 2012, he completed a PhD thesis on the mechanics of architectured materials at Ecole des Mines de Paris. In 2013, he collaborated with EZCT Architecture & Design Research for Archilab, as a materials processing and structural engineering consultant. Recently, he initiated a graduate program on materials & additive manufacturing in Paris, open to both engineering and architecture students. He is leading the DEMOCRITE research project, funded by heSam Université, between CNAM, Arts et Métiers-ParisTech, ENSA Paris-Malaquais, ENSCI-Les Ateliers, and INRIA, aiming at developing additive manufacturing at the architectural scale. His research interests are related to the morphological structures of matter at different scales within materials. He is particularly involved in the design, modelling, simulation, optimisation, and processing of architectured materials, which result from the unholy alliance between metallurgy, mechanics, and geometry. He recently co-founded XtreeE, a startup company providing large-scale additive manufacturing services.

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