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# TOWARDS DESIGNING 3D PRINTED COMPONENTS WITH FUNCTIONALLY GRADED METAMATERIALS

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## ABSTRACT

Additive manufacturing brings a change of paradigm on how industrial component design is being addressed, eliminating many of the manufacturing constraints. 3D printing quality is becoming parallel to that of traditional techniques and is reaching micron resolutions in a wide range of materials. There is almost no additional effort in printing designed microstructures at the microscale that have salient or ad libitum mechanical properties when the new designed "material" (metamaterial) is seen at the continuum scale. A given component may also have different mechanical requirements at different locations and, hence, different metamaterials would be optimal at different locations. The optimum design of a component is that optimized simultaneously at two scales (continuum and microscale) and made of functionally graded metamaterials to fulfil the localized mechanical requirements. Reaching practical procedures for this two-scale concurrent optimization of 3D printed components using functionally graded metamaterials requires advances in many techniques like fully characterizing the relevant mechanical properties of 3D printed materials and metamaterials, modelling plasticity and fracture in 3D printed metamaterials at small and large strains, topology optimization techniques for a wide range of local mechanical requirements, efficient multiscale techniques, surrogate models for efficient inverse analysis, methods for transitions in functionally graded structures, and devising value-added industrial components that can largely benefit from this technology.

Topics of interest of this session are related to these needed techniques to reach the change in paradigm in the design of components towards a simultaneous optimization of the component and the (meta-) material at each location in that component for a wide variety of mechanical requirements.