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RECENT DEVELOPMENTS IN OPTIMAL DESIGN OF COMPOSITE MATERIALS AND STRUCTURES

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ABSTRACT

The objective of this minisymposia is to provide a forum to identify the state of the art, discuss recent advances and future challenges, and present current and novel applications within the field of optimal design of composite materials and structures.
Composite materials are an assembly of different constituent materials with dissimilar properties which remain separate in the final structure. The mechanical properties of the composite material excel those of its constituents. The most common of this type of materials is perhaps fibre reinforced plastics or laminated composite materials where strong and stiff load carrying fibres (e.g., carbon or glass) are bonded together within a weak and compliant matrix (e.g., epoxy). From an optimal design standpoint, the challenge is no longer to optimize only the structural topology or shape but also the properties of the material at each point of the design domain. Successfully tailoring the local material properties it is possible to control the global structural response to achieve stiffer, stronger, lighter, and thus more cost effective design solutions.
Research in the field of optimal design of composite structures has been very intense over the past years. The problem formulations combine constraints associated with the linear (e.g., static displacements), nonlinear (e.g., panel buckling) and dynamic (e.g., natural frequencies) structural response. Furthermore, manufacturing constraints on the physical construction of the composite structure have also been included. Finally, various parameterizations have been suggested which motivated the different approaches used in the field, e.g., topology optimization among other. The choice of parameterization is therefore a key issue in order to guarantee that optimal designs of composite materials and structures are obtained.
The challenges include the efficient solution of very large-scale optimal design problems incorporating coupled multi-physics constraints, relevant production and manufacturing requirements, and advanced modelling techniques. Moreover, novel methods are required to address problems combining simultaneous optimization of material properties, and structural topology and shape. Lastly, it is necessary to ensure that the latest theoretical and numerical developments are applicable in an industrial setting.
In summary, this minisymposia will serve as a vehicle for the promotion of new interactions and strengthening of already existing bonds between different academic and industry research groups working in the field of optimal design of composite materials and structures.