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Structural shape optimization of the thermal concentrator by isogeometric analysis and particle swarm optimization method

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Recently, there has been a growing interest towards controlled heat flux manipulation to increase the efficiency of thermal apparatus. Hence, so called heat manipulators, which control and manipulate the heat flow, have garnered a lot of attention from research community. A key to the effective performance of these heat manipulators is their thermal design. For designing a heat manipulator, thermal metamaterials are often utilised due to their unique properties [1, 2] that are not possible with naturally occurring materials. In this work, we focus on a thermal metamaterial based concentrator (concentrates the heat flux in the specified region of the domain). The main scope of the current work is to optimize the shape of concentrator using Particle Swarm Optimization (PSO) method. The geometry is defined using NURBS basis functions due to the higher smoothness and continuity and the thermal boundary value problem is solved using Isogeometric Analysis (IGA). Furthermore, some of the control points of the geometry are considered as the design variables. The optimized shape generated by PSO is compared with the other shape exploited in the literature [1, 3]. The effect of the number of design variables, the thermal conductivity of member materials as well as some of the geometry parameters on the optimum shape is also demonstrated.

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