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The Concurrent Design of Materials and Structures for Cellular Materials on Efficiency of Heat Dissipation

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This paper describes an analytical model for heat transfer of cellular materials and presents a method for optimal design of increasing its efficiency of heat dissipation. The method is based on topology optimization techniques and finds the optimal topology within a given design section and the volume constraint. Two classes of design variables, volume density and local aperture, are applied not only to optimize macro material distribution as well as the local material topology, so-called concurrent design, but also to avoid confused interpretation for the checkerboard patterns. Several numerical results for material distribution are described in detail by illustration. As a result, accurately and practicably, the numerical method would guide the design of optimum cellular structures that would maximize heat transfer per unit pumping power. This paper is divided into six major sections as follows. The first section is introduction. The problem is described by section 2. The optimization problem is explained in section 3. In the following section, the sensitivity analysis is carried out. Four numerical examples are showed in section 5. In the last section, we will draw the conclusion.
Key words: topology optimization, cellular materials, concurrent design of materials and structures, heat dissipation.

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