Morphing Tree Structure For Latent Thermal Energy Storage

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Abstract

we report the numerical study of time dependent storage of energy by melting a phase change material in two- and three-dimensional enclosures. Energy storage is essential in designs for the effective utilization of unsteady and random renewable energy (e.g., solar energy and wind energy) by storing the energy in the form of latent heat during the high-availability period, for later use. Traditionally, the study of latent heat storage is based on models where the heating entity, wall or embedded pipe, is solid and stationary. In our sudy, the heating is provided along moving invading lines, which change from single-line invasion to tree-shaped invasion. The numerical simulation is conducted in COMSOL and incorporates both conduction and convection heat transfer mechanisms with the objective of discovering the geometric features that lead to the fastest melting process. The results show that the history of the amount of melted material is S-shaped. We also found that the fastest melting (i.e., the steepest S curve) is discovered by allowing the tree architecture to morph freely, toward greater access over time. The stem length and branching angle of invading trees can be selected such that the complete melting process is shorter. The melting process can also be made faster by increasing the complexity of the tree structure

Figures used in the abstract

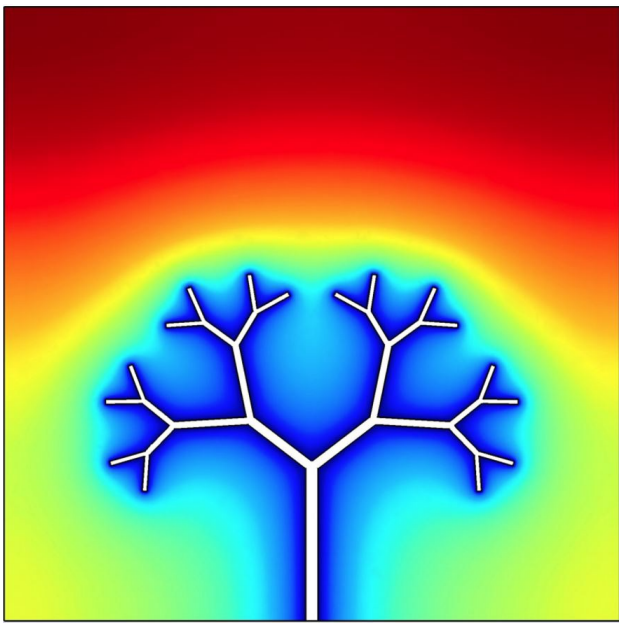

Figure 1 : improving energy storage with a cue from nature