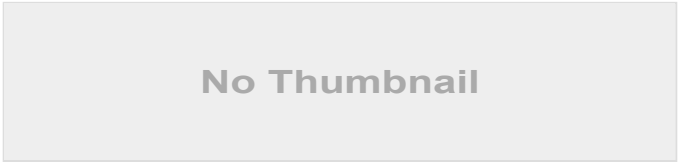
Direct Scalar Field - to - Truss Representation and Stress Simulation of Open Pore Domains



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Abstract
In the domain of lattice and porous material geometric modeling, the problem of data size is central. When using full 3D manifold Boundary Representations (BRep), even the smallest domains engender staggering amounts of 3D finite elements. A partial solution has been implemented, which represents slender solid neighborhoods with non-manifold Boolean union of 1- manifolds (curves) and/or 2-manifolds (surfaces), added with thickness information, called 1.5D and 2.5D models, respectively. Automatic applications of these techniques requires the estimation of the medial axis of the porous media, to produce a truss or frame FEA. Previous works require explicit synthesis of the skin of the porous domain. This manuscript presents an alternative in which the medial axis and thus the 1.5D (truss) representation of the porous domain is directly obtained from the scalar field (i.e., Computer Tomography -CT-) of the domain, thus avoiding the explicit calculation of the domain skin. The manuscript also presents the noise removal and linearization of the medial axis data, to obtain the skeleton truss graph (including bar radii), that represents the porous domain. Shear and tension load simulations are conducted with the Truss model, showing that the generated model can be used in FEA software. Future work is required in extending this concept to lattice materials, where the medial axis includes surfaces and not only curves, as in this manuscript.

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