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基于栅格法的球床内流道六面体网格生成算法

摘要

球床式高温气冷堆堆芯中大量燃料元件的无序堆积形成了高度复杂的孔隙结构，给堆芯的热工水力分析带来了巨大挑战。特别是在开展相关高精度计算流体力学模拟时，生成几何接触点附近的网格往往存在问题。针对该网格生成问题，本文提出了一种基于栅格法的全六面体网格生成算法，以实现对任意堆积球床中流道的网格自动划分。该方法首先基于栅格法在计算域内生成初始的六面体核心网格，并通过投影至几何边界生成贴体网格。为实现更好的网格质量，算法还引入了缓冲层和网格优化算法等改进措施。通过算例测试了该全六面体网格生成算法的性能表现，结果表明，算法生成的网格可满足高精度 CFD 模拟的要求，为球床反应堆的热工水力分析提供了可靠的技术支持。

关键词

计算流体动力学；球床堆芯；六面体网格生成算法

Abstract

The porous geometry of randomly packed pebble bed has led to great challenges in the thermal-hydraulic analysis inside the reactor. Specifically, in the development of meshes for computational fluid dynamics (CFD) simulations of transport in randomly packed pebble beds, particle–particle and wall–particle contact points often present difficulties. To get high-quality meshes with relatively few elements, an automatic hexahedral meshing algorithm for randomly packed pebble bed using a grid-based method is proposed. Hexahedral core mesh is first generated and then projected to boundary to generate conformal mesh. Refinements to the algorithm include insertion of a buffer layer and mesh optimization. Several examples are shown to demonstrate the capability of our hexahedral mesh generation method for pebble bed geometries.

Keywords

Computational fluid dynamics; Particle bed reactor; Hex-Mesh generation

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