

流体力学与传递现象

## Chebyshev配置点谱方法直接求解离散坐标辐射传递方程

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摘要

针对三维长方形炉内具有吸收-发射介质的辐射换热, 基于Chebyshev配置点谱方法和Schur分解开发了直接求解辐射离散坐标方程的求解器。针对离散后所得到的三维矩阵方程, 分别用两种方法进行求解, 一种是用张量积将三维转变成二维然后用Schur分解求解; 另一种是自行开发三维Schur分解直接求解。数值实验表明, 在相同的输入参数下, 新求解器具有很好的精度, 尤其相比于标准离散坐标法, 新求解器能节省大量计算时间。特别是基于三维Schur分解的直接求解器, 在相同的输入参数下, 计算时间只有标准离散坐标法的10%~1%。

关键词

[辐射换热](#) [离散坐标法](#) [Chebyshev配置点谱方法](#) [Schur分解](#)

分类号

## Direct solvers for discrete ordinates equations based on Chebyshev collocation spectral method

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### Abstract

Based on the Chebyshev collocation spectral method and Schur decomposition, two direct solvers for radiative discrete ordinates equations for a three-dimensional rectangular furnace with absorbing-emitting medium are developed. For the three-dimensional matrix equation from discretization of the radiative transfer equation, one solver is based on two-dimensional Schur decomposition after the transform of three-dimensional matrix equation to two-dimensional one using tensor product, and the other is based on three-dimensional Schur decomposition, which is developed in the present work. With the same parameters, the numerical experiments indicate that the new solvers can provide good accuracy. Compared with the standard discrete ordinates method, the new solvers are much faster, leading to less CPU time. Specially, the CPU time of the new solver based on the three-dimensional Schur decomposition is just 10%—1% of the standard discrete ordinates method.

### Key words

[radiative heat transfer](#) [discrete ordinates method](#) [Chebyshev collocation spectral method](#) [Schur decomposition](#)

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