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带旋转修正的弹簧-TFI混合动网格方法

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Spring-TFI Hybrid Dynamic Mesh Method with Rotation Correction

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摘要 网格存在大变形时,传统的超限插值(TFI)动网格方法易于引起网格正交性问题。依据几何关系并考虑其插值特点,提出了一种带旋转修正的TFI动网格方法。对结构网格块进行分块,在子块角点间建立弹簧元,并基于弹簧类比法计算角点位移;子网格内部结点位移采用修正后的TFI动网格方法进行计算,从而形成具有弹簧-TFI混合特征的动网格新方法。以典型二维及三维黏性网格为例进行方法的有效性研究。结果表明,在显著大变形情况下,引入旋转修正得到了正交性和光顺性良好的变形网格。另外,该方法的计算效率较传统TFI动网格方法有所降低,但相比弹簧方法提高1到2个量级。

关键词: 动网格 旋转修正 弹簧类比法 超限插值 计算流体力学

Abstract: Problems of orthogonal properties become more serious when the traditional transfinite interpolation (TFI) dynamic mesh method is employed for large deformations. Based on an analysis of the geometric relationship and interpolation features, an improvement for the present TFI method is proposed with a rotation correction. A new spring-TFI hybrid dynamic mesh method is developed for a structured mesh. First, each block of the computation domain is divided into several sub-blocks. Then, a spring network which connects the corners of all sub-blocks is established to smooth the mesh by means of spring analysis. Finally, a modified TFI method is used for calculating the inner deformations of the sub-blocks. Computational results of typical two and three dimensional viscous grids indicate that good orthogonal and smoothing properties can be achieved by rotation correction for large mesh deformations. In addition, the computational efficiency is slightly decreased than the traditional TFI method, but improved by 1 or 2 orders of magnitude when compared with the spring analogy method.

Keywords: dynamic mesh rotation correction spring analogy method transfinite interpolation computational fluid dynamics

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