作者	黄炳彬
中文题名	复杂边界水沙数学模型的斜对角笛卡尔方法研究
英文题名	Diagonal Cartesian Method for Flow and Suspended Sediment Transport Modeling Involving Compex Boundary
中文关键词	复杂边界；水沙数学模型；斜对角笛卡尔方法
英文关键词	complex boundary, water and sediment mathematical medels, diagonal Cartesian method
中文文摘	在二维水沙数学模型计算中，对复杂不规则动态边界的处理一直是人们关心的重点，在水沙数学模型计算中如何处理不规则的复杂边界将直接影响到整个模型计算结果的可靠性、精度和计算时间。选择复杂边界的处理方法与算法的选择有着同等重要性。对此，人们提出了多种不规则复杂边界的处理方法，如：贴体坐标法、非结构网格法、多重网格法以及直角坐标系统下的锯齿法、插值法、混合法等，这些方法各有优缺点。 传统的差分法使用的时间最长，目前使用得也最普遍，但该方法造成锯齿状边界为计算的精度及计算效率带来了很大困难，本论文采用斜对角笛卡尔坐标方法对河流、湖泊、海洋中常用的浅水波方程组（包括连续方程和运动方程）进行离散，该方法不仅保留了锯齿法正交、易形成计算网格、计算效率高等特点，同时又能有效地改善锯齿法拟合边界精度差的缺点，更能贴近实际，使边界流场更加合理。 泥沙输移的对流扩散方程采用通常的差分离散时往往在锯齿状边界处不易保证质量守恒。本论文在采用斜对角笛卡尔方法时，重点考虑了边界处对流扩散方程的质量守恒格式，其计算点的选择与水流计算中流速、水深计算点相互耦合，这一方面保证了泥沙计算在边界处的精度，同时在网格生成和程序设计处理上更加简单。 本论文将建立的斜对角笛卡尔坐标方法应用于福建泉州湾海床稳定性分析平面二维水沙数学模型之中，计算所得流场与含沙量浓度场吻合较好，表明该方法在水利、海洋等平面二维水沙计算中简单、高效，具有很好的应用前景。该论文同时还计算分析了泉州湾在各种工程条件下（包括滩涂围垦、建港、泄沙等）研究区域泥沙输移规律，为科学决策核电工程的方案打下了坚实的基础。 关键词：复杂边界、水沙数学模型、斜对角笛卡尔方法
外文文摘	In the 2D mathematical models, the complex irregular dynamic boundary is the key point for the calculations, which will impact directly reliability, accuracy and calculation time of the whole calculation results. To choose treatment method of complex boundary is as important as to choose numerical method. As the result, the people apply lots of treatment methods for irregular complex boundary, such as boundary-fitted coordinate system, unstructured mesh, overset grids and saw-tooth method, interpolation method, blending method under Cartesian coordinate system. These methods have their own advantages and disadvantages. Traditional differential method has been used long time and is most widely used today. However, this method results in saw-tooth boundary that brings much difficulty on accuracy and efficiency of calculation. This paper applies diagonal Cartesian coordinate method to discretize shallow-water equations (including continuation equations and momentum equations) widely used in rivers, lakes and seas. This method takes the advantages of saw-tooth method’s normal, easiness to form calculation grids and high calculation efficiency. On the other hand, it can efficiently overcome the defects that the boundary accuracy of saw-tooth method is low, and is closer to real conditions and makes more reasonable boundary flow field. Convection-diffusion equations of sediment transport cannot also provide mass conservation around the saw-tooth boundary when adopting usual differential methods. This paper mainly considers mass conservation format of convection-diffusion equations in the boundary when applying diagonal Cartesian methods. Choice of calculation points is coupled with calculation points of velocity, water depth in flow calculation. This can give accuracy of sediment calculation near the boundary. At the same time, it makes grid creation and program design much easier. This paper applies the diagonal Cartesian coordinate method to 2D water-depth averaged flow and sediment mathematical models for seabed stability analysis of Quanzhou bay in Fujian province. Both velocity and sediment concentration calculation results agree well with the measurement, which shows that the method is efficient in the calculation for hydraulics and costal

	engineering and has the good application prospect. This paper also calculates and analyzes sediment transport laws in research area under various engineering conditions (including beach inning, port building, engineering acquirement for water, sediment discharge and so on). This will build the solid foundation for making scientific decisions of various schemes for nuclear power project in Quanzhou bay. Keywords: complex boundary, water and sediment mathematical models, diagonal Cartesian method.
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