

<<离散曲面的变分原理>>

图书基本信息

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前言

This book consists of mathematical and algorithmic studies of geometry of polyhedral surfaces based on the variations principles. The part of mathematics is based on a lecture series given by Feng Luo at the Center of Mathematical sciences at Zhejiang University, China, in June and July 2006. The algorithmic theory and applications to computer graphics are based on the work of Xianfeng Gu and are written by him. The task of writing the part of mathematics of the note was done by Junfei Dai who prepared them with great care and made a number of improvements in the exposition. The aim of this book is to introduce to the students and researchers an emerging field of polyhedral surface geometry and computer graphics based on variation principles. These variational principles are derived from the derivatives of the cosine law for triangles. From mathematical point of view, one of the most fascinating identity in low-dimensional polyhedral geometry is the Schläfli formula. It relates in a simple and elegant way the volume, edge lengths and dihedral angles of tetrahedra in the spheres and hyperbolic spaces in dimension 3. The formula can be considered as a foundation of 3-dimensional variational principles for triangulated objects. For a long time, mathematicians have been considering the Gauss-Bonnet formula as the 2-dimensional counterpart of Schläfli. The recent breakthrough in this area was due to the work of Colin de Verdière in 1995 who found the first 2-dimensional identity relating edge lengths and inner angles similar to the Schläfli identity. The mathematical work produced in this book can be considered as establishing all 2-dimensional counterparts of Schläfli formula. It turns out there are continuous families of Schläfli type identities in dimension 2. These identities produce many interesting variational principles for polyhedral surfaces. In the part of mathematics of the book, we are focusing on a study of the rigidity phenomena on polyhedral surfaces. Some moduli space problems are also discussed in the book. In the part of algorithm of the book, we introduce discrete curvature flow from both theoretical and practical points of view. Discrete curvature flow is a powerful tool for designing metrics by prescribed curvatures. The algorithm maps general surfaces with arbitrary topologies to three canonical spaces. Therefore, all geometric problems of surfaces in 3D space are converted to 2D ones. This greatly improves the efficiency and accuracy for engineering applications. The discrete Ricci flow algorithm, and Ricci energy optimization algorithm are rigorous, robust, flexible and efficient. They have been applied for surface matching, registration, shape classification, shape analysis and many fundamental applications in practice.

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内容概要

This book intends to lead its readers to some of the current topics of research in the geometry of polyhedral surfaces with applications to computer graphics. The main feature of the book is a systematic introduction to geometry of polyhedral surfaces based on the variational principle. The authors focus on using analytic methods in the study of some of the fundamental results and problems on polyhedral geometry, e. g., the Cauchy rigidity theorem, Thurston's circle packing theorem, rigidity of circle packing theorems and Colin de Verdiere's variational principle. With the vast development of the mathematics subject of polyhedral geometry, the present book is the first complete treatment of the subject.

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