<<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 polyhedralsurfaces based on the variations principles. The part of mathematics is based on a lectureseries given by Feng Luo at the Center of Mathematical sciences at Zhejiang Univer-sity, China, in June and July 2006. The algorithmic theory and applications to computergraphic are based on the work of Xianfeng Gu and are written by him. The task of writingthe part of mathematics of the note was done by Junfei Dai who prepared them with greatcare and made a number of improvements in the exposition.The aim of this book is to introduce to the students and researchers an emergingfield of polyhedral surface geometry and computer graphics based on variation princi-ples. These variational principles are derived from the derivatives of the cosine law fortriangles. From mathematical point of view, one of the most fascinating identity in low-dimensional polyhedral geometry is the Schlaefli formula. It relates in a simple and el-egant to way the volume, edge lengths and dihedral angles of tetrahedra in the spheresand hyperbolic spaces in dimension 3. The formula can be considered as a foundation of3-dimensional variational principles for triangulated objects. For a long time, mathemati-cians have been considering the Gauss-Bonnet formula as the 2-dimensional counterpartof Schlaefli. The recent breakthrough in this area was due to the work of Colin de Verdierein 1995 who found the first 2-dimensional identity relating edge lengths and inner anglessimilar to the Schlaefli identity. The mathematical work produced in this book can beconsidered as establishing all 2-dimensional counterparts of Schaefli formula. It turns outthere are continuous families of Schlaefli type identities in dimension 2. These identi-ties produce many interesting variational principles for polyhedral surfaces. In the partof mathematics of the book, we are focusing on a study of the rigidity phenomena onpolyhedral 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 boththeoretical and practical points of view. Discrete curvature flow is a powerful tool fordesigning metrics by prescribed curvatures. The algorithm maps general surfaces with ar-bitrary topologies to three canonical spaces. Therefore, all geometric problems of surfacesin 3D space are converted to 2D ones. This greatly improves the efficiency and accuracyfor engineering applications. The discrete Ricci flow algorithm, and Ricci energy opti-mization algorithm are rigorous, robust, flexible and efficient. They have been applied forsurface matching, registration, shape classification, shape analysis and many fundamentalaoolications in oractice.

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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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The launch of this Advanced Lectures in Mathematics series is aimed at keepingmathematicians informed of the latest developments in mathematics, as well asto aid in the learning of new mathematical topics by students all over the world.Each volume consists of either an expository monograph or a collection of signifi-cant introductions to important topics. This series emphasizes the history andsources of motivation for the topics under discussion, and also gives an overviewof the current status of research in each particular field. These volumes are thefirst source to which people will turn in order to learn new subjects and to dis-cover the latest results of many cutting-edge fields in mathematics.

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