

<<黎曼-芬斯勒几何导论>>

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作者：[美]David Dai-Wai Bao,[美]Shiing-Shen Chern,[美]Zhongmin Shen

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前言

The subject matter of this book had its genesis in Riemann's 1854 "habilitation" address : "Über die Hypothesen , welche der Geometrie zu Grundeliegen" (On the Hypotheses , which lie at the Foundations of Geometry) . Volume II of Spivak's Differential Geometry contains an English translation of this influential lecture , with a commentary by Spivak himself. Riemann , undoubtedly the greatest mathematician of the 19th century , aimed at introducing the notion of a manifold and its structures. The problem involved great difficulties. But , with hypotheses on the smoothness of the functions in question , the issues can be settled satisfactorily and there is now a complete treatment. Traditionally , the structure being focused on is the Riemannian metric , which is a quadratic differential form. Put another way , it is a smoothly varying family of inner products , one on each tangent space. The resulting geometry — Riemannian geometry — has undergone tremendous development in this century. Areas in which it has had significant impact include Einstein's theory of general relativity , and global differential geometry. In the context of Riemann's lecture , this restriction to a quadratic differential form constitutes only a special case. Nevertheless , Riemann saw the great merit of this special case , so much so that he introduced for it the curvature tensor and the notion of sectional curvature. Such was done through a Taylor expansion of the Riemannian metric. The Riemann curvature tensor plays a major role in a fundamental problem. Namely : how does one decide , in principle , whether two given Riemannian structures differ only by a coordinate transformation ?

This was solved in 1870 , independently by Christoffel and Lipschitz , using different methods and without the benefit of tensor calculus. It was almost 50 years later , in 1917 , that Levi-Civita introduced his notion of parallelism (equivalent to a connection) , thereby giving the solution a simple geometrical interpretation.

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内容概要

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