



# Differential Geometry of Spray and Finsler Spaces

*Zhongmin Shen*

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## **Differential Geometry of Spray and Finsler Spaces** Zhongmin Shen

In this book we study sprays and Finsler metrics. Roughly speaking, a spray on a manifold consists of compatible systems of second-order ordinary differential equations. A Finsler metric on a manifold is a family of norms in tangent spaces, which vary smoothly with the base point. Every Finsler metric determines a spray by its systems of geodesic equations. Thus, Finsler spaces can be viewed as special spray spaces. On the other hand, every Finsler metric defines a distance function by the length of minimal curves. Thus Finsler spaces can be viewed as regular metric spaces. Riemannian spaces are special regular metric spaces. In 1854, B. Riemann introduced the Riemann curvature for Riemannian spaces in his ground-breaking Habilitationsvortrag. Thereafter the geometry of these special regular metric spaces is named after him. Riemann also mentioned general regular metric spaces, but he thought that there were nothing new in the general case. In fact, it is technically much more difficult to deal with general regular metric spaces. For more than half century, there had been no essential progress in this direction until P. Finsler did his pioneering work in 1918. Finsler studied the variational problems of curves and surfaces in general regular metric spaces. Some difficult problems were solved by him. Since then, such regular metric spaces are called Finsler spaces. Finsler, however, did not go any further to introduce curvatures for regular metric spaces. He switched his research direction to set theory shortly after his graduation.

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