Chikuse

Statistics on Special Manifolds

The special manifolds of interest in this book are the Stiefel manifold and the Grassmann manifold. Formally, the Stiefel manifold Vk,m is the space of k frames in the m-dimensional real Euclidean space Rm, represented by the set of m x k matrices X such that X' X = I, where Ik is the k x k identity matrix, k and the Grassmann manifold Gk,m-k is the space of k-planes (k-dimensional hyperplanes) in Rm. We see that the manifold Pk,m-k of m x m orthogonal projection matrices idempotent of rank k corresponds uniquely to Gk,m-k. This book is concerned with statistical analysis on the manifolds Vk,m and Pk,m-k as statistical sample spaces consisting of matrices. The discussion is carried out on the real spaces so that scalars, vectors, and matrices treated in this book are all real, unless explicitly stated otherwise. For the special case k = 1, the observations from V1,m and G1,m-l are regarded as directed vectors on a unit sphere and as undirected axes or lines, respectively. There exists a large literature of applications of directional statis tics and its statistical analysis, mostly occurring for m = 2 or 3 in practice, in the Earth (or Geological) Sciences, Astrophysics, Medicine, Biology, Meteo rology, Animal Behavior, and many other fields. Examples of observations on the general Grassmann manifold Gk,m-k arise in the signal processing of radar with m elements observing k targets.

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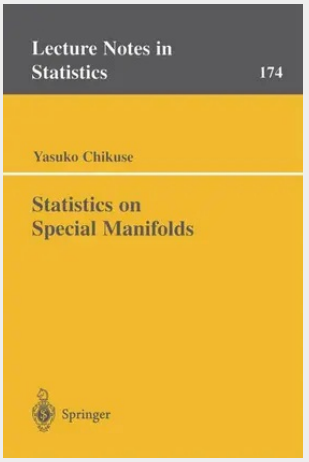

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