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Information geometry of covariance matrix: Cartan-Siegel homogeneous bounded domains, Mostow/Berger fibration and Fréchet median. (English) Zbl 1319.62072


Summary: Information Geometry has been introduced by Rao, and axiomatized by Chentsov, to define a distance between statistical distributions that is invariant to non-singular parameterization transformations. For Doppler/Array/STAP radar processing, the information geometry approach will give a key role to homogenous symmetric bounded domains geometry. For radar, we will observe that information geometry metric could be related to Kähler metric, given by the Hessian of Kähler potential (entropy of radar signal given by $-\log[\det(R)]$). To take into account the Toeplitz structure of the time/space covariance matrix or Toeplitz-Block-Toeplitz structure of the space-time covariance matrix, parameterization known as partial Iwasawa decomposition could be applied through a complex autoregressive model or multi-channel autoregressive model. Then, hyperbolic geometry of the Poincaré unit disk or symplectic geometry of the Siegel unit disk will be used as natural space to compute the “p-mean” ($p = 2$ for “mean”, $p = 1$ for “median”) of the covariance matrices via Karcher flow derived from a Weiszfeld algorithm extension on the Cartan-Hadamard manifold. This new mathematical framework will allow the development of an ordered statistic (OS) concept for Hermitian positive definite covariance space/time Toeplitz matrices or for space-time Toeplitz-Block-Toeplitz matrices. We will define ordered statistic high Doppler resolution CFAR (OS-HDR-CFAR) and ordered statistic space-time adaptive processing (OS-STAP).

For the entire collection see [Zbl 1252.94003].

MSC:

- 62F99 Parametric inference
- 32M15 Hermitian symmetric spaces, bounded symmetric domains, Jordan algebras (complex-analytic aspects)
- 94A12 Signal theory (characterization, reconstruction, filtering, etc.)

Full Text: DOI