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Sujet de Thèse :

Stochastic modeling using the methods of information geometry: Application to texture analysis.

Abstract :

In this thesis, we study the characterization of images through stochastic models in the wavelets domain. Usually heeled by information theory, the state of the art proposes models that permit to analyse textures by purely statistical tools such as mutual information or Kullback-Leibler divergence. In this context, we proposed to represent color images through novel information called the extended relative phase (ERP) information using circular stochastic models, which allows us to consider the existing correlation between color subbands through univariate models. Afterward, our main goal was to leverage the information geometry methods to give a geometric perspective to the stochastic modelling by treating statistical models as manifolds. In this light, we proposed two manifolds namely, the Generalized Gamma distribution (GΓD) and the Multivariate Generalized Gamma distribution (MGΓD). The GΓD is appropriate for representing gray-level, as well as color textures when considering the in dependence between color channels. The MGΓD manifold for its part fits well the dependence structure between wavelet subbands of color texture components. Both manifolds are equipped with the geodesic distance as one of the major advantages of the geometric study since it is as an intu itive, natural, and intrinsic similarity measure. However, the calculation of the GD on the proposed manifolds appeared to be very cumbersome and needs numerical approximations. To deal with this, we provided three dif ferent approaches to approximate the geodesic distance using mappings to some embedded sub-manifolds, a piecewise affine approximation, as well as a graph-based approach that approximates the whole manifold. The performance of the proposed approaches is evaluated through the Content Based Image Retrieval (CBIR) system. The obtained results show that the ERP information of inter-channel improves the retrieval performances with a minimum cost. Results also reflect the efficiency of the geodesic distance on statistical manifolds, which confirms the need of information geometry tools to complete the pure information-theoretic characterization of textures.