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An Approach to the Gaussian Detection Problem

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ABSTRACT

This poster is concerned with the problem of detecting Gaussian signals in white Gaussian noise. Classically, this problem is solved by reducing firstly the continuous-time observation set to an equivalent discrete-time set via the Karhunen-Loève (K-L) expansion and then by applying Grenander's Theorem. The main difficulty of this approach is that the likelihood ratio found depends explicitly on eigenvalues and eigenfunctions of the covariance kernel involved, because there is no standard method to compute them. Therefore, the likelihood ratio is usually rewritten in another form that is suggestive of a more efficient implementation of the corresponding signal detection system and that provides an interesting interpretation for the likelihood ratio. This form is the *estimator-correlator* representation of the likelihood ratio, which depends on the causal MMSE estimator of the signal. This optimum estimator may be obtained by means of the Kalman-Bucy filter if the signal verifies a state-space model. However, this assumption cannot always be imposed. There is a great number of physical phenomena do not satisfy this assumption.

The aim of this poster is to show that the modified approximate K-L expansion, which is based on the approximate eigenvalues and eigenfunctions calculated from the Rayleigh-Ritz method, allow to obtain a solution to the problem of detecting Gaussian signals in white Gaussian noise circumventing the above difficulties. Such a solution is easily implementable on a computer and does not require the calculation of true eigenvalues and eigenfunctions. Moreover, we prove that the estimator-correlator representation of the likelihood ratio can be approximated by a similar form based on a suboptimal filter derived from the modified approximate K-L expansion. Such a suboptimal filter becomes an alternative approach to the Kalman-Bucy filter in order to determine the optimum linear estimator of the signal when a state-space model is not readily at hand.

References

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