Selection of observation points in kriging based on non-convex programming

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Kriging (Matheron, 1963) is a method of interpolation for a stochastic field in the spatial domain. The procedure of kriging is as follows: the first step is to estimate the semivariogram, which determines the spatial covariation of stochastic field and the second step is to solve a linear equation with respect to observations and the semivariogram so that the predictions are the best linear unbiased predictors. Kriging is widely used in various fields such as solar radiation forecasting (Alsamamra et al., 2009), radon concentration prediction (Zhu et al., 1996), and circuit variability analysis (Yelten et al., 2012).
Since the ordinary kriging uses all observation data, it requires prohibitive computational cost when immediate estimates at many points are needed in the case of, for example, an urgent evaluation of earthquake hazards. For reduction of the computation cost, Yang et al., (2014) proposed to implement least absolute shrinkage and selection operator (lasso) on kriging. However, a convex regularization term is not efficient enough to select observation points because it does not match the constraint that the predictions are unbiased. Therefore we propose to carry out kriging based on non-convex programming.
The non-convex programming problems here have the hyperplane constraint, and the objective function is the sum of a quadratic form and a non-convex penalty term such as 1) L1-L2 regularization term proposed by Lou et al., (2015) and 2) L1-largest-K regularization term proposed by Gotoh et al., (2015). These problems belong to DC programming, in which objective functions can be represented as the difference of two convex functions. Approximate solutions of such problems can be obtained by DC algorithm proposed by Tao (1986), which is now a general approach to DC programming.
A numerical experiment shows that the L1-L2 regularization term and L1-largest-K regularization term work well for selection of observation points in kriging although lasso does not work efficiently.

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