# MEG Source Localization Via Bayesian Kernels

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**Introduction:** Sampling electromagnetic brain signals at milliseconds absorbed lots of attention to mangetoencephalograpy (MEG) during past couple of decades. Yet, few numbers of spatial recordings has limited the inverse problem spatial resolution. This ill-posedness can be overcome introducing different types of priori information by means of covariance component. Because of huge number of sources (of order 10000) lots of parameters shall be estimated in Covariance components.

In this work Bayesian kernels are taken to model inverse mapping from sensor space to the sources. Covariance kernel is replaced by low rank estimation which includes less number of parameters to be estimated.

**Method:** Gaussian regression models the inverse mapping in an infinite dimensional feature space. Considering normal distribution for regressors and estimation error, the solution includes a huge kernel gram matrix which plays the same role as the covariance component in well established empirical Bayes, variational Bayes, or automatic relevance determination approaches. To deal with this huge matrix it is approximated as kronecker product of two terms: sources covariance kernel and sensors covariance kernel; both of which are approximated via low rank substitutions. Restricted maximum likelihood is used for error variance estimation.

**Result:** Simulation results with the MEGtools software shows one order of magnitude improvement in the average mean square error over the standard minimum norm (MN) solution. The average focality is improved by 40 percent over the MN solution. The average peak-to-peak error is reduced by 35 percent.

**Conclusion:** Kernel method describes an alternative framework to deal with the MEG inverse problem. The flexibility of kernels and their low rank matrix approximation can help to deal better with such underdetermined problem. Applying such low rank estimation transfers the source localization problem from covariance component estimation to source magnitude ordering estimation. Such approach can be considered as one step forward to present mathematical models of macroscopic voxel activities in electromagnetic brain mapping.