# Space-Time Sparse MEG Reconstruction

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**Abstract**

The ill-posed nature of the magnetoencephalographic (MEG) inverse problem has motivated use of constraints to regularize the solution to the corresponding least squares problem. Examples of constraints include restricting the solution to lie on the cortical surface and use of penalties to constrain the solution's norm or number of active terms. In particular, sparse solutions are encouraged using $\ell_1$ penalties, but $\ell_1$ penalties tend to produce spiky solutions that lack continuity in space or time. In this talk we present the concept of space-time sparsity (STS) penalization, which encourages solutions to the inverse problem consisting of a small number of space-time events. A space-time event describes activity that occurs over a limited, yet contiguous time span and has local spatial support on the cortical surface. We describe such events using multiple spatio-temporal basis functions. The STS penalty is then defined as the sum across events of the $\ell_\infty$ norm of the coefficients of each space-time event. This penalizes only the largest coefficient associated with each event and favors solutions consisting of a sparse set of space-time events. We present a novel expectation-maximization algorithm for finding a minimum of the STS penalized least squares problem and illustrate its performance using both simulated and human subject data.