Title: Multivariate matching pursuit analysis of MEG evoked fields.
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Abstract

One of the main goals of multivariate analysis of brain evoked fields is source localization. This problem is hard in terms of robustness and complexity of computations. Matching Pursuit (MP) is a time-frequency analysis method that allows for robust, in respect to noise, detection of signal structures. MP results in time-frequency sparse description of an input data and another method has to be applied in order to estimate source's location. An stand-alone MP-based inverse solution method called Spatio Temporal Matching Pursuit (STMP) was constructed and validated on both simulated and experimental data. The information about physiologically feasible brain activity sources is included in the new algorithm and used in the analysis resulting in the signal simultaneous time-frequency-source sparse description. The simulations showed superiority of this method over the old two-step approaches and another state of art methods called RAP-MUSIC. The execution time of the STMP is plausible due to application of smart mathematical procedure for reducing the otherwise heavy computational problem. While MP was able to separate brain activities if they differ in terms of time or frequency parameters, STMP is able to separate also based on the source location. If almost identical activities origin from different brain locations e.g. right and left hemisphere, STMP allows for addressing the tiny differences while MP recognize all these activities as a single component. The new method takes advantage of both MP and physiological knowledge in order to efficiently estimate the time course and locations of brain sources based on MEG data.

The second extension of MP algorithm presented in this thesis is called Contrast Matching Pursuit (CMP) and refers to the way psychological experiments are constructed. CMP performs input signal decomposition taking into account the information about the part of the experiment the data come from. This information could be the experimental condition and it can be helpful in case an extra brain activity is expected in one of the conditions. CMP is on the early stage of development so it is presented here just as an idea.