Summary

Magnetoencephalography (MEG) is a non-invasive neuroimaging technique that is capable of investigating the human brain activity through the recording of the magnetic fields generated by the electric fields in the brain. A main area of research using MEG is the localisation of the sources in the brain that are responsible for the observed magnetic fields. The inverse MEG problem addresses the reconstruction of the sources through source localisation. It is ill-posed as there are infinitely many solutions to the observations recorded when no prior information or constraints are assumed.

In this thesis, the main focus will be on the estimation of the locations of the sources through the inverse modeling of the MEG problem. A time dependent forward model was assumed. To solve the inverse problem, a non-linear optimisation in the brain volume was performed to identify the parameters of the sources and the mean square error (MSE) was implemented as the constraint to determine the global minimum in the non-linear optimisation.

Statement of author's contribution

In the analysis of the data, I designed a head model to match the orientation of the magnetometers provided by segmenting the brain, skull and scalp information from another data set. The MSE is a new method to measure the goodness of fit of the sources identified in the inverse model. In Section 3, I introduce three methods to try and identify a unique solution to the ill-posed problem. I improvised the methods and the final method used in the analysis is an exhaustive search in the brain volume through a non-linear optimisation which incorporates the goodness of fit.