Selecting the regularisation parameter for linear Electrical Impedance Tomography of brain function

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ABSTRACT: Electrical Impedance Tomography could provide a portable non invasive method for imaging brain function, of particular use in assessing brain development in newborn infants. Selecting the regularisation parameter is important for linear image reconstruction. We compared the solution error norm with L-curve (LC), Discrepancy Principle (DP), Generalised Cross Validation (GCV) and the Unbiased Predictive Risk Estimator (UPRE) selection methods, with and without modelling a general covariance matrix of the noise, on simulated data using an anatomically accurate FEM of the neonatal head and impedances changes due to blood flow in the visual cortex. In addition, the data was reconstructed with or without modelling using the general covariance matrix (GCM), in order to compensate because noise in EIT data is not white. Without GCM, the solution error was worse for DP, but no significant differences were found among the other three methods. With GCM, the solution error was improved for all methods, and LC and GCV were best. In human data recorded during visual stimulation in ten neonatal infants, there was no significant difference among selection methods in terms of the SNR, while modelling a diagonal covariance matrix of the noise did decrease the SNR. We recommend that GCV be employed for reconstruction of human neonatal images, and encourage the development of a better way of estimating the covariance of the noise, which has been shown to enhance results for a good estimate.

Keywords: regularisation parameter, linear model, covariance matrix.

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