A non-linear image reconstruction method for multi-frequency EIT of strokeusing spectral constraints

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Thrombolytic drugs are available for treating ischaemic stroke that relieve the clot and restore blood flow. Imagingof pathological brain function must be performed to distinguish between ischaemic and haemorrhagic stroke before the drug is administered. Application of Electrical Impedance Tomography (EIT) to imaging stroke could result in fast administration of life-saving thrombolytic drugs and significantly improve the outcome of treatment. Multi-frequency EIT has been proposed for the purposes of stroke classification as it allows for the imaging of an event without knowledge of a baseline.We present a novelmethod forperforming multi-frequency EITbyinclusion oftissue information in the image reconstruction algorithm.A parameterization of the conductivity distribution in terms ofindividual tissue conductivity values and fraction, or weighting,functionsis performed. Boundary voltage data acquired for multiple frequencies is employed todirectly reconstruct frequencyindependent fraction parameter distributions for each tissue. A numericalstudyhas been performed to investigate the feasibility of reconstructing fraction images of a perturbation in frequency-dependent background from voltage data simulated using a 3D head shaped mesh. Images of the fraction parameters have been reconstructedfrom time difference, frequency difference and weighted frequency difference datausing a linear method.The comparison with conventional conductivity images reconstructed with the same data and inversion method shows a reduction in noise level in the case of the fraction images. The proposed approach allows for the inclusion of spectral conductivity information of blood, healthy and ischaemic brain tissue in a non-linear multi-frequency reconstruction method for classification of stroke. Furthermore,this approach allows for the use of frequency difference data in the inverse problem formulation and the subsequent subtraction of modeling errors. Fraction images have been reconstructed using non-linear methods and compared with corresponding absolute conductivity images. Work in progress is to assess the validity of theproposed approach in mixed-tissue elements and to account for variability in tissue conductivity.