UNCERTAINTY QUANTIFICATION ANALYSIS OF CONDUCTIVITY RECONSTRUCTION IN ELECTRICAL IMPEDANCE TOMOGRAPHY

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ABSTRACT

Electrical impedance tomography (EIT) is a boundary measurement inverse technique which aims to reconstruct the conductivity distribution of the interior of a physical body based on boundary measurement data. Typically, the measured data are uncertain due to various error sources, which leads to many uncertainties in the image reconstruction. This paper attempts to quantify these effects of the measurement errors on the EIT reconstruction. To this end, a comprehensive framework is proposed by combining the uncertainty quantification techniques and EIT domain knowledge. In which, a polynomial chaos expansion method is used to construct the surrogate model for the complex conductivity field. Two shape detection indices are developed to show the quality of an EIT reconstruction. Finally, under some constraints of the detection indices, statistical and sensitivity analysis are performed using the property of the surrogate model. Several EIT problems have been examined, a simple case with one or two anomalies in a circle domain is first studied, where only part of the measurement errors are treated as uncertainties. The one anomaly case and a more realistic case with two asymmetric anomalies in a body-like domain are then discussed when all the measurement errors are taken as input uncertainties. The results show that the proposed framework is able to quantify the effect of the measurement errors on the EIT reconstruction at a reasonable cost. Further, for the test cases, it is shown that the measurement errors at the electrodes, which are close to the anomaly, are the most influential factors in the image reconstruction. More detailed results will be shown in the final poster presentation.

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