**Sensitivity Volume as Figure-of-Merit for Maximizing Data Importance in Electrical Impedance Tomography**

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ABSTRACT

Electrical impedance tomography (EIT) is a noninvasive electrical imaging modality whereby resistance measurements are taken via electrodes along the surface of a conducting medium to map the internal conductivity distribution. This method shows great promise for nondestructive evaluation (NDE). However, standard EIT methods include low amplitude measurements which add noise to the inverse problem without adding much signal, and this noise can propagate through the inverse problem, distorting the fidelity of the inverted image. This talk introduces a **figure of merit** for comparing measurement protocols in the EIT problem, namely the **sensitivity volume**, which identifies which set of measurements is most sensitive to changes in conductivity and therefore least susceptible to noise-induced distortion.

EIT is a computed tomography method that solves an inverse problem that is not necessarily well-posed. The corresponding forward problem, within the linear regime, maps the conductivity distribution to the data using a Jacobian matrix $J$. The **sensitivity volume** metric proposed here utilizes the rows of the Jacobian matrix as sensitivity vectors in model space. The longer the vector, the more sensitive a given measurement is to the model features, and the more orthogonal two vectors are to each other in model space, the more their corresponding measurements reveal independent information about the conductivity map. For a given set of $D$ measurements selected from among these rows, these sensitivity vectors span a $D$-dimensional volume in model space $S^{D}=\sqrt{J^{T}J}$, mathematically defined as the square root of the determinant of the Jacobian times its transpose. By choosing the measurement set of $D$ vectors that maximize this volume, the overall sensitivity and mutual independence of the selected measurements is maximized, correspondingly. The resulting improvement in signal-to-noise can be used to increase the speed, fidelity, or resolution of the reconstructed conductivity image.

**Keywords:** electrical impedance tomography, inverse problems, measurement optimization, nondestructive evaluation

REFERENCES

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