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Robust Electrical Impedance Tomography Imaging: Extensions of D-bar Methods to Deep Learning and Super Resolution

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ABSTRACT

In Electrical Impedance Tomography (EIT), electrical measurements are taken on electrodes at the body's surface and a mathematical inverse problem is solved to recover the electrical conductivity/admittivity inside the body. As electrical properties are tissue dependent, EIT images may then be used to monitor heart and lung function in ICU patients, classify strokes (ischemic vs. hemorrhagic) and breast tumors (benign vs. malignant), and provide nondestructive evaluation of construction materials. The most common solution methods for EIT solve an optimization problem to minimize the error between measured and predicted data (e.g. voltage/current data) therefore requiring a finely-tuned forward model. By contrast, D-bar methods solve the inverse problem directly by using a tailor-made nonlinear Fourier transform of the measured boundary voltage/current allowing real-time imaging. Low-pass filtering of the transform data provides robustness to noise as well as incorrect boundary shape modeling for static as well as time-difference imaging. In this talk, we explore how the benefits of a priori knowledge can be embedded into D-bar methods to provide reconstructed images with sharp boundaries important in medical imaging. Extensions to partial boundary data as well as super-resolution and machine learning are discussed. Reconstructions from experimental EIT data are presented.