A Scalable Deep Learning Model for Simultaneous Reconstruction and Transmitter Localization in Inverse Scattering

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Abstract—Traditionally, the methods for inverse scattering can be broadly classified as non-iterative and iterative methods. Non-iterative methods rely on linear approximations which make them faster. On the other hand, iterative methods account for the non-linearity and, though time consuming, provide much better reconstruction. In recent times, Deep Neural Network (DNN) based methods have become prominent and provide state-of-the-art results in inverse scattering. They are fast and also provide reliable reconstruction. However, both traditional and DNN based methods assume the knowledge of the locations of the transmitters and receivers. The precise knowledge of these locations requires either a careful placement of the transmitters and receivers at specific known locations or placing the transmitters and receivers at arbitrary locations and using an appropriate system to calculate their respective locations. These locations are then fed to the reconstruction algorithm. Having to determine the locations of transmitters and receivers is an additional overhead and reduces the ease of usability of the system. Also, any change in their locations necessitates a re-calibration of the system. In case of DNNs, a change in these locations would imply retraining the model as DNN based methods trained for a particular set of transmitter and receiver locations do not perform well on a different set of locations. Therefore, in this work, we propose a method for simultaneous reconstruction and localization of transmitters in a multiple-incidence scenario. In [1], simultaneous reconstruction and localization of the transmitter in a single-incidence scenario was proposed. The method involved a grid search over the possible transmitter locations to obtain the location with the lowest value for a specific cost function. However, in a multiple incidence scenario, the complexity of grid search increases exponentially with each incidence. To circumvent this problem, we propose to use a scalable DNN model [2]. The DNN based method in [2] was designed to work for arbitrary transmitter configurations by first processing each incidence independently before combining the estimates to obtain the final reconstruction [2]. By leveraging the independent processing of each incidence used in [2], we bring down the complexity of the grid search from the exponential to the linear regime in the multiple incidence scenario.

REFERENCES
