A Warm-basis Method for bridging learning and iteration: a case study in Fluorescence Molecular Tomography

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Fluorescence Molecular Tomography (FMT) is a widely used non-invasive optical imaging technology in biomedical research. It usually faces significant accuracy challenges in depth reconstruction, and conventional iterative methods struggle with poor z-resolution even with advanced regularization. Supervised learning approaches can improve recovery accuracy but rely on large, high-quality paired training dataset that is often impractical to acquire in practice. This naturally raises the question of how learning-based approaches can be effectively combined with iterative schemes to yield more accurate and stable algorithms. In this work, we present a novel warm-basis iterative projection method (WB-IPM) and establish a relevant theoretical foundation. The method is able to achieve significantly more accurate reconstructions than either of the learning-based or iterative-based methods. In addition, the method allows a weaker loss function depending solely on the directional component of the difference between ground truth and neural network output, thereby substantially reducing the training effort. These features are justified by our error analysis as well as real and simulated experiments.