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A Warm-basis Method for Bridging Learning and Iteration: a Case Study in Fluorescence Molecular Tomography



姜嘉骅
上海科技大学

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Abstract: 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 its theoretical underpinnings. The method is able to achieve significantly more accurate reconstructions than the learning-based and iterative based methods. In addition, it 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 simulated and real-data experiments.

个人简介:姜嘉骅博士2013年获中国科学技术大学学士学位，2018年获得麻省大学达特茅斯分校博士学位。2018-2020年，赴弗吉尼亚理工大学开展博士后研究。此后，担任英国伯明翰大学助理教授，现任上海科技大学长聘副教授。姜嘉骅博士主要从事模型降阶，不确定性量化，反问题在图像处理上的应用等方面的研究。在SISC, JSC, Inverse problem, Nature Communications, Laser & Photonics Reviews等多个应用数学和工程领域的核心期刊上发表论文。同时，还担任JSC, JCP等多个国际重要学术期刊的审稿人。