DEVELOPING PROBABLISTIC MACHINE LEARNING MODELS FOR ION IMAGING ANALYSIS

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Since their inception, charged-particle imaging techniques have transformed how chemical reactions and dynamics are studied. Ion imaging is a powerful detection method for many as it allows for higher resolution measurements for photoion and photoelectron spectroscopic experiments and photodissociation dynamics. Although there have been many experimental innovations over the last two decades, major advancements in how we analyze these images are few and far between. A general weakness found in ion imaging experiments is low signal-to-noise ratios, which are intrisic to all single particle detection methods. Motivated by the development of convolutional neural networks (CNN) for general imaging applications, we explored the ability of using CNNs for ion imaging reconstruction with the goal to parametrize a neural network to learn the approximate mapping between the ion image projection and its central distribution. We demonstrate the effectiveness of our model to not only reduce noise in the reconstructed image but also produce sharp images. We also compare with standard image reconstruction methods to quantitatively show the improvements by our method on real spectroscopic images. We have also made the model publicly available on Github.