Deep Convolutional Neural Networks for the Generation of High Fidelity Images from Radio Interferometer Visibility Data

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Last year, the SETI Institute in collaboration with IBM, lead an effort to apply convolutional neural networks to the problem of identifying the class of unknown signals in simulated single-dish radio telescope data, with much success. In this paper we look at a different problem in radio astronomy, the construction of high fidelity images from stored correlator visibility files. This work is motivated by the amazing recent successes of CNN autoencoders developed for photographic image processing in the machine learning community. The second half of a photographic autoencoder has a structure very similar to what would be required for image generation from raw radio interferometer data (visibilities). In this paper, we argue that a deep convolutional neural network (CNN) can be a highly (computationally) effective approach to radio interferometer image generation starting from raw visibilities and producing high fidelity, cleaned (deconvolved) images as an output. We consider the linear and nonlinear operations performed in image generation and how they have analogs in a standard CNN. We also discuss the potential computational cost savings that might be had by replacing our complicated image processing pipelines with neural networks. A toy model CNN is developed and initial results will be presented.