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Scattering Transform for Analysing Galactic Morphology

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Convolutional neural networks (CNNs) are supervised deep learning algorithms which reduce input data into a set of features for classification or other analysis. While various studies have established the ability of CNNs in recognizing galaxy morphologies [1], identifying galaxy-scale strong gravitational lenses [2], or as source finders [3], these networks often suffer from generalizability and interoperability problems [4]. The networks must be trained on a dataset with sufficient statistics, often with thousands of instances of the different features or classes that the network must learn. For any new problem or task, the network must be trained on the new data or the network parameters must be tuned with transfer learning. However, there are several methods to combat these issues.

Feature extraction techniques can be hard-coded into the network structure, minimising the amount of trainable network parameters. Of particular interest is the scattering transform [5], which embeds the wavelet transform in a recursive structure similar to a CNN. These wavelet scattering networks have no trainable parameters, but have been demonstrated to be competitive with traditional neural networks for measuring cosmological parameters. This flexible and powerful framework can be used for image classification [7] and generation without any deep learning, or combined with deep learning architectures, reducing the amount of trainable parameters in the network.

Here we compare hybrid scattering transform networks with the LiSA network developed for the SKA Science Data Challenge 2 for HI source identification and characterization.

References

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