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Auto-identification of unphysical source reconstructions in strong lens modelling

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With the advent of next-generation surveys and the expectation of discovering huge numbers of strong gravitational lens systems, much effort is being invested into developing automated procedures for handling the data. The several orders of magnitude increase in the number of strong galaxy-galaxy lens systems is an insurmountable challenge for traditional modelling techniques. Whilst machine learning techniques have dramatically improved the efficiency of lens modelling, parametric modelling of the lens mass profile remains an important tool for dealing with complex lensing systems. In particular, source reconstruction methods are necessary to cope with the irregular structure of high-redshift sources. In this paper, we consider a Convolutional Neural Network (CNN) that analyses the outputs of semi-analytic methods which parametrically model the lens mass and linearly reconstruct the source surface brightness distribution. We show the unphysical source reconstructions that arise as a result of incorrectly initialised lens models can be effectively caught by our CNN. Furthermore, the CNN predictions can be used to automatically re-initialise the parametric lens model, avoiding unphysical source reconstructions. The CNN accurately classifies source reconstructions with a precision P>0.99 and recall R>0.99. Using the CNN predictions to re-initialise the lens modelling procedure, we achieve a 69 per cent decrease in the occurrence of unphysical source reconstructions. This combined CNN and parametric modelling approach can greatly improve the automation of lens modelling.

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