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Domain Adaptation in Gravitational Lens Analysis

Upcoming surveys are predicted to discover galaxy-scale strong lenses on the magnitude of 10^5, making deep learning methods necessary in lensing data analysis. Currently, there is insufficient real lensing data to train deep learning algorithms, but training only on simulated data results in poor performance on real data. Domain adaptation can bridge the gap between simulated and real datasets. We adopt domain adaptation on the estimation of Einstein radius in simulated galaxy-scale gravitational lensing images. We evaluate two domain adaptation techniques - domain adversarial neural networks (DANN) and maximum mean discrepancy (MMD). We train on a source domain of simulated lenses and apply it to a target domain with emulation of DES survey conditions. We show that both domain adaptation techniques can significantly improve the model performance on the more complex target domain datasets. Our results show the potential of using domain adap- tation to perform analysis on future survey data with a deep neural network trained on simulated data.

Primary authors: SWIERC, Paxson; ZHAO, Yifan(Megan)

Co-authors: CIPRIJANOVIC, Aleksandra (Fermi National Accelerator Laboratory); NORD, Brian (Fermilab)

Presenters: SWIERC, Paxson; ZHAO, Yifan(Megan)

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