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Gradient reversal for MC/real data calibration

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In the research, a new approach for finding rare events in high-energy physics was tested. As an example of physics channel the decay of \tau -> 3 \mu is taken that has been published on Kaggle within LHCb-supported challenge. The training sample consists of simulated signal and real background, so the challenge is to train classifier in such way that it picks up signal/background differences and doesn't overfits to simulation-specific features. The approach suggested is based on cross-domain adaptation using neural networks with gradient reversal. The network architecture is a dense multi-branch structure. One branch is responsible for signal/background discrimination, the second branch helps to avoid overfitting on Monte-Carlo training dataset. The tests showed that this architecture is a robust a mechanism for choosing tradeoff between discrimination power and overfitting, moreover, it also improves the quality of the baseline prediction. Thus, this approach allowed us to train deep learning models without reducing the quality, which allow us to distinguish physical parameters, but do not allow us to distinguish simulated events from real ones. The third network branch helps to eliminate the correlation between classifier predictions and reconstructed mass of the decay, thereby making such approach highly viable for great variety of physics searches.

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