Multi-Task Convolutional Neural Network for Pose-Invariant Face Recognition

Abstract—This paper explores Multi-Task Learning (MTL) for face recognition. First, we propose a multi-task Convolutional Neural Network (CNN) for face recognition where identity classification is the main task and Pose, Illumination, and Expression (PIE) estimations are the side tasks. Second, we develop a dynamic-weighting scheme to automatically assign the loss weights to each side task, which solves the crucial problem of balancing between different tasks in MTL. Third, we propose a pose-directed multi-task CNN by grouping different poses to learn pose-specific identity features, simultaneously across all poses in a joint framework. Last but not least, we propose an energy-based weight analysis method to explore how CNNbased MTL works. We observe that the side tasks serve as regularizations to disentangle the PIE variations from the learnt identity features. Extensive experiments on the entire Multi-PIE dataset demonstrate the effectiveness of the proposed approach. To the best of our knowledge, this is the first work using all data in Multi-PIE for face recognition. Our approach is also applicable to in-the-wild datasets for pose-invariant face recognition and achieves comparable or better performance than state of the art on LFW, CFP, and IJB-A datasets.

CONCLUSIONS

This paper explores multi-task learning for face recognition with PIE estimations as the side tasks. To solve the problem of balancing each task in MTL, we propose a dynamic-weighting scheme to automatically assign the loss weights to each side task during the training process. This scheme is shown to assign a larger loss weight to an easier side task and/or the most helpful side task. We also propose a pose-directed multi-task CNN to learn pose-specific identity features during training and a stochastic routing scheme for feature fusion in the testing stage.

SOFTWARE:

- MATLAB

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