Video Anomaly Detection using Unsupervised Deep Learning Methods

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Abstract

Video anomaly detection has played a significant role in computer vision tasks and video surveillance tasks. To detect anomalies in videos we need to address two problems: 1) anomalies are difficult to define, different situations have different anomalies, and 2) the limited anomaly samples: abnormal events and behaviors are unusual temporal or spatiotemporal parts of videos. To address the above challenges and reduce the computational and memory cost, in this thesis, we propose unsupervised deep learning and end-to-end methods for temporal and spatiotemporal anomaly detection, respectively.

For temporal anomaly detection, we formulate it as *fake data* detection via the discriminative framework of a designed 3D-GAN. This new formulation only employs normal videos during the training phase and detects anomalies according to the deviation estimated by the discriminator of 3D-GAN. For spatiotemporal anomaly detection, we design a 3D fully convolutional autoencoder that is trainable in an end-to-end manner to learn the spatiotemporal representation of normal visual patterns and how to reconstruct them with low errors. Subsequently, spatiotemporal patterns can be detected as blurry regions that are not well reconstructed. We evaluate the proposed methods for detecting abnormal patterns on benchmark video datasets. Compared with state-of-the-art approaches, experiment results demonstrate the effectiveness of our methods.