Sub-Image Anomaly Detection with Deep Pyramid Correspondences

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Abstract. Nearest neighbor (kNN) methods utilizing deep pre-trained features exhibit very strong anomaly detection performance when applied to entire images. A limitation of kNN methods is the lack of segmentation map describing where the anomaly lies inside the image. In this work we present a novel anomaly segmentation approach based on alignment between an anomalous image and a constant number of the similar normal images. Our method, Semantic Pyramid Anomaly Detection (SPADE) uses correspondences based on a multi-resolution feature pyramid. SPADE is shown to achieve state-of-the-art performance on unsupervised anomaly detection and localization while requiring virtually no training time.

Keywords: anomaly detection, nearest-neighbors, feature pyramid

1 Introduction

Humans observe many images throughout their lifetimes, most of which are of little interest. Occasionally, an image indicating an opportunity or danger appears. A key human ability is to detect the novel images that deviate from previous patterns triggering particular vigilance on the part of the human agent. Due to the importance of this function, allowing computers to detect anomalies is a key task for artificial intelligence.

As a motivational example, let us consider the setting of an assembly-line fault detection. Assembly lines manufacture many instances of a particular product. Most products are normal and fault-free. Unfortunately, on isolated occasions, the manufactured products contain some faults e.g. dents, wrong labels or part duplication. As reputable manufacturers strive to keep a consistent quality of products, prompt detection of the faulty products is very valuable. As mentioned earlier, humans are quite adept at anomaly detection, however having a human operator oversee every product manufactured by the assembly line has several key limitations: i) high wages earned by skilled human operators ii) limited human attention span ([14] states this can be as low as 20 minutes!) iii) a human operator cannot be replicated between different assembly lines. iv) different operators typically do not maintain a consistent quality level. Anomaly detection therefore calls for computer vision solutions.