

Abstract:

Deep learning has revolutionized machine learning and computer vision in the past few years, through dramatic accuracy improvements in traditional computer vision problems such as object recognition and detection. Recently, these advances have been applied to the overhead imagery domain, where similar increases in performance have been observed on detection problems. In developing deep learning algorithms for overhead imagery analytics, two primary challenges must be addressed: low resolution compared with consumer-level images on which most deep learning has been applied; and a relatively small amount of labeled training data. To address the first challenge, we have adapted deep learning networks built for character recognition, tailored for small image patches and a constrained problem domain, to detect vehicles in satellite imagery. To compensate for small amounts of labeled training data, we are using DIRSIG to generate training examples of vehicles for detection and change detection. We are also exploring model adaptation, semi-supervised and unsupervised network learning methods combined with user interaction for image search and online, supervised learning. Results on Digital Globe imagery validate that deep learning out-performs previous state-of-the-art methods for object detection; models trained with DIRSIG-generated examples can operate well on observed imagery; and our methods for limited training data have significant promise for reducing the need for large amounts of labeled data typically required for deep learning approaches.