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# Identification and Instance Segmentation of Oil Spills Using Deep Neural Networks

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***Abstract*** **-** Oil spills impact natural and built environments, people and communities, food chain, and wildlife, and the road to full recovery is often long and costly to businesses, contractors, communities, and local governments. Existing oil spill detection methods including in-situ measurements and remote sensing primarily depend on involving skilled personnel in data collection, processing, and analysis, which could be expensive, slow, and subjective (influenced by prior experience, and judgment of problem parameters or solution space). In addition, oil pipelines and platforms can be located in remote and harsh areas, making it difficult and even hazardous for engineers to conduct timely inspections. Applying artificial intelligence (AI) can streamline this process and create more objective measures of oil spill and leakage detection. In this research, deep learning models, namely VGG-16 and mask R-CNN (mask region-based convolutional neural network) are employed to identify and locate oil spills. These models represent state-of-the-art object recognition algorithms in computer vision. Red-green-blue (RGB) training images are collected using semi-supervised learning (i.e., keyword search) from the web. This initial visual dataset consists of a diverse set of photos taken by unmanned aerial vehicles (UAVs) or first-person cameras from previous oil spill accidents. The methodology consists of model training and validation, image classification, object detection, and semantic segmentation. The VGG16 model is used for image classification (to predict the existence of oil spill in an image) and yields an accuracy of ~93%. The mask R-CNN model is used for instance segmentation (to detect oil spills and marking their boundaries at pixel-level) and yields average precision and recall of 61% and 70%, respectively. Results can create opportunities for advancing the current practice of integrating AI and data analytics into downstream and upstream operations in the oil and gas industry, as well as enabling non-intrusive techniques for detection of environmental pollutants.

***Keywords*****:** Deep neural networks; oil spills; classification; instance segmentation; drones.