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Revolutionizing Oil Spill Detection: A Machine Learning Approach for Satellite Image Classification

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Abstract:
Identifying and labeling oil spills in satellite imagery is an essential activity of both environmental monitoring and disaster response actions. This work is dedicated to applying an Artificial Neural Network (ANN) model for gathering oil spill data by using a dataset that is specially curated for this reason. Our dataset was developed from satellite pictures of the ocean, some of which depict oil spills and some that do not. The features were extracted from each picture using computer vision algorithms. Our ANN model is trained to distinguish between two classes: The metrics that are looked at consist of accuracy, sensitivity, specificity, PPV, NPV, and statistical significance, and they illustrate how the model performs. As a result, the ANN model gets an accuracy of 96.88% and a sensitivity of 92.86% at the same time, while the specificity is 99.88%. The sensitivity of this diagnostic test is 96.30%, and the specificity is 94.74%. A p-value of 0.985997 means that the reported finding reaches a statistical significance, which is enough to support our hypothesis. This can be concluded from the results of ANN, showing the potential of this model to successfully classify the image patches into two sets, namely the ones covered by oil spills and the oil spill-free ones. The research work is a great contribution to the development of the area of environmental monitoring through the machine learning methods used for quick and appropriate detection of environmental hazards.

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Contents

Studies were conducted to combat the persistent oil spill hazards that affect marine life and coastal communities [1]–[3]. Realizing that quick and reliable oil spill detection cannot be overemphasized for environmental safeguards [4], the studies delve into the machine learning method that utilizes satellite technology [5]–[7]. This new technology is revolutionary in mapping; it features an accurate and comprehensive solution that is much more affordable and scalable than manual surveys. The research applies a unique dataset tailored for training the machine-learning model, on which the annotated satellite image patches represent the presence or absence of oil spills [8], [9]. We will illustrate the core capacities of the machine learning systems, namely, their ability to classify pollution accurately and recognize essential image elements for trustworthy labeling. Summing up, the report depicts the mastering of the Sigchi Learning Reading the dataset, the training, and the model. The study ends by applying the model to new data that has not been tested before in the context of model applicability and functionality in a real-world setting. This research data can significantly impact environmental monitoring because the information will be accurate and can detect the oil spill in record time. The paper is based on ideas of more data sources, such as weather data and historical discharge dynamics, which should upgrade the model precision [10], [11]. Thus, it reminds us that cutting-edge machine learning systems are being developed to provide more advanced tools for oil spill detection so that the ecosystem can be protected. The study aims to contribute to the scientific community and environmental organizations by providing a toolkit and knowledge to help them ensure marine protection measures are implemented after an oil spill.

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