Supplemental Information for

Application of Transfer Learning and Convolutional Neural Networks for Autonomous Oil Sheen Monitoring

Jialin Dong [1], Katherine Sitler [2], Joseph Scalia [2], Yunhao Ge [3], Paul Bireta [4], Natasha Sihota [4], Thomas P. Hoelen [4] and Gregory V. Lowry [1,*]

[1] Department of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA
[2] Department of Civil and Environmental Engineering, Colorado State University, Fort Collins, CO 80523, USA
[3] Department of Computer Science, University of Southern California, Los Angeles, CA 90007, USA
[4] Chevron Technical Center, San Ramon, CA 94583, USA
*Correspondence: glowry@cmu.edu

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Details of Image Selection

There were a total of 51 tests for the OS-SS conducted in the lab, including 5 oils of varying viscosities. The crude oil information can be found in Sitler et al. 2020, section 3.1, Table 2 Crude oil properties. The slick characteristics observed (in terms of color, thickness etc.) can be found in Sitler et al. 2020, APPENDIX D – COLUMN TEST RESULTS.

Table S1. Input data summary table

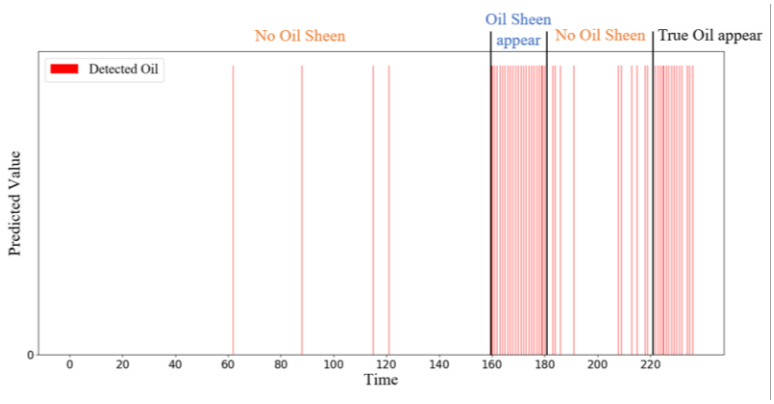
	Recorded in Thesis	Videos for training model	Class Labels
Rainbow sheen	37	36	With sheen Or No sheen
Metallic sheen	7	7	With sheen Or No sheen
No sheen	7	7	No sheen
Total Numbers	51	50	

Table S2 OS-Net performance under different data augmentation methods

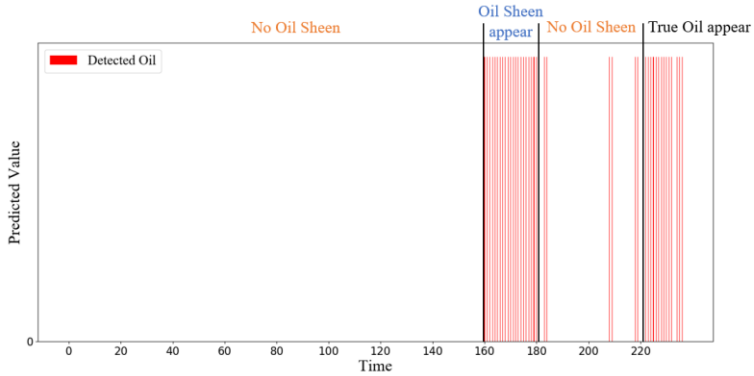
	None	Horizontal Flip	Vertical Flip	Rotation	Contrast	All methods
Accuracy	0.98701	0.9965	0.9838	0.9448	0.9513	0.909091

Table S3 OS-Net hyperparameters tuning grid search values

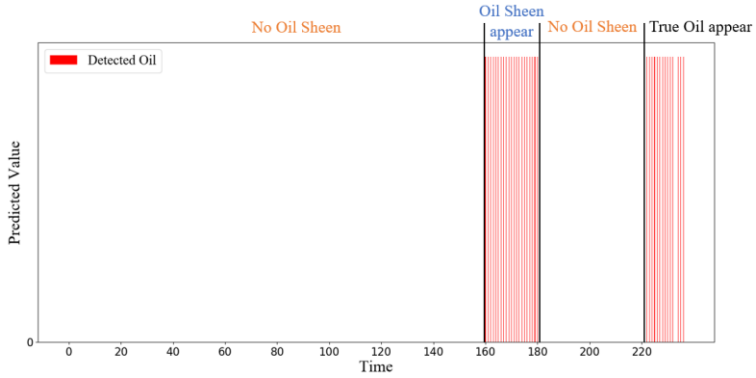
Hyperparameter	OS-Net Without Transfer Learning	OS-Net With Transfer Learning Feature Extraction Strategy	OS-Net With Transfer Learning Fine-tuning Strategy
Learning rate (initial)	0.0001, 0.001, 0.002, 0.003, 0.005, 0.01, 0.02, 0.05, 0.1		
Learning rate scheduler (step_size)	1, 2, 3, 5, 6, 10		
Learning rate scheduler (gamma)	0.001, 0.01, 0.1, 0.2		
Batch size	4, 8,16, 32, 64, 128		
epoch	10, 20, 30, 50, 100		
momentum	0.01, 0.1, 0.6, 0.7, 0.8 0.9, 0.99		



(a) Oil sheen prediction with filter (k = 1)



(b) Oil sheen prediction with filter (k = 2)



(c) Oil sheen prediction with filter (k = 3)

Figure S1. VOS-Net prediction results. The X axis shows the prediction index with time (1 prediction / s) and the Y axis shows the VOS-Net prediction result. The black line represents the region where there was oil sheen present. Ground truth labels are shown at the top of each region.

Figure S1 (a) shows the oil sheen prediction result on a single video by VOS-Net. In the early times of the video when no oil sheen is present, there are a few false positive events that predict an oil sheen when it is not present. If we use the VOS-Net on real-time oil sheen prediction without a filter, these false positives (red lines in the initial "no oil sheen" region) would lower the accuracy of the model. Based on the videos, when present, oil sheen persists for at least seconds, i.e. multiple frames of video. To improve the accuracy, we set a filter with kernel size k in the VOS-Net, where k represents the threshold of positive prediction; i.e. we suppress the positive prediction until we have k successive positive predictions. Figure S1 (b) shows the VOS-Net result after adding a filter (k = 3). This suppresses the false positive prediction, increasing the accuracy of VOS-Net for oil sheen prediction.