Crude oil remote sensing, characterization and cleaning with CW and pulsed lasers

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Abstract

For detection, identification and characterization of crude oil we combine several optical methods of remote sensing of crude oil films and emulsions (coherent fringe projection illumination (CFP), holographic in-line interferometry (HILI), and laser induced fluorescence). These methods allow the three-dimensional characterization of oil spills, important for practical applications. Combined methods of CFP and HILI are described in the frame of coherent superposition of partial interference patterns. It is shown, that in addition to detection/identification laser illumination in the green-blue region can also degrade oil slicks. Different types of surfaces contaminated by oil spills are tested: oil on the water, oil on the flat solid surfaces and oil on the curved surfaces of pipes. For the detection and monitoring of the laser-induced oil degradation in pipes, coherent fiber bundles were used. Both continuous-wave (CW) and pulsed lasers are tested using pump-probe schemes. This finding suggests that properly structured laser clean-up can be an alternative environmentally-friendly method of decontamination, as compared to the currently used chemical methods that are dangerous to environment.