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THE WATER POLLUTION VIDEO-DETECTION SYSTEM FOR NEVA RIVER

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Introduction

Annually, the Committee for Nature Management in St. Petersburg fixes more than 40 oil spills on the Neva River due to the system of lidars using for the detection of oil pollution. Lidars are located under the bridges and transmit laser radiation after a predetermined interval of time to the water surface [1]. Upon receipt of oil spill detection signal the emergency services respond instantly, but the oil spill can move to considerable distance and the determination of its new location causes difficulties. Therefore, for the rapid detection of the oil spill accidents it was necessary to create an automated video fixing system capable to detect oil pollution on the water surface at any time of day.

Study of existing oil pollution detection systems

Detection of the oil film on the water surface is possible due to the capability of oil film to change the physical state of the surface due to changes in the wave and foaming under the influence of the film [2]. Since 2007 in St. Petersburg a system of lidars installed on ten bridges is used for the detection of oil pollution. With their help both discharges from urban enterprises and incoming oil spills are tracked. However, they have a few drawbacks: there is a possibility of false alarms due to the accumulation of algae and impossibility of source of pollution determination. Laser methods can be combined with telemetry methods to eliminate this problem.

Study of oil pollution video detection system

Weather conditions in St. Petersburg are very unpredictable. Therefore, cameras should work in difficult observation conditions, such as rain, snow, hail, fog. It is necessary that the system includes several different cameras to receive a complete picture of what is happening on the water at any time.

Thermal cameras are often used to detect oil contamination. Typical sensitivity of modern thermal imagers is 0.1°C. Radiation temperatures of water and oil have a difference in the daytime of about 1 to 2°C, at night 0.5 to 1°C. This is enough for thermal imaging cameras to provide a rather contrasting picture. Also the brightness change with an equal contrast of the area under consideration and the effect of smoothing the ripples inside the oil slick can be used to detect pollution.

Thus, for continuous observation of the water area the video module should consist of a high-resolution color camera, a television low-level camera with an anti-fog function and an uncooled thermal imaging camera.

The thermal camera must have a sensitivity of not more than 0.1°C. The resolution of the color camera should be sufficient to reproduce the presence of light from the capillary ripples to detect slicks. A black-and-white camera should have a high sensitivity for observation at night.

Based on the hydrophysical characteristics of the Neva, the magnitude of the contrast of the oil film against the background of pure water reaches a maximum when the camera is directed to the water surface at an angle of 45°. Also, the analysis of the water area showed that it is advisable to monitor the water area from the shaded and windward side to avoid background illumination of the system.

The maximum focal length and the angle of the lens required to detect oil contamination at a distance of 25 meters from the camera is 60 mm and 3 degrees respectively [2]. Using a lens with such characteristics, we can see a spot at a distance of 25 meters in size from 2 to 50 meters.

The image from the cameras should be available simultaneously to several users and access to video information should be provided both in real time and by viewing the video archive.

Conclusion

The lidar oil detection systems used in St. Petersburg are far from perfect. A video fixing system with some necessary characteristics of video equipment was proposed. Requirements for software were identified.

References

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