

## Under water camera image processing for robot vision

### Introduction to Fleet Cleaner

Fleet Cleaner develops and deploys robots for ship's hull cleaning. We are an innovative techno startup based in Delft and have recently entered into the commercial phase. With our unique robot we offer the most complete solution for ship hull cleaning on the market. The robot is able to remove all the fouling from the ship's hull, thereby reducing fuel costs. The cleaning is performed both above and under water, during loading and unloading in port - resulting in no down-time for the vessel.

### Research objectives

An essential topic for R&D is the robot's ability to sense and interpret the environment. Obtaining visual data is a key method for gathering knowledge of the environment, which provides the (human) operator of the robot with visual feedback and facilitates the cleaning operation. Currently, three optical cameras (2 front, 1 back) are used to provide a live feed and collection of images during the operation. Due to varying conditions of water quality (e.g. turbidity) and weather conditions (lightning, wind, currents) the images are of different - and more often than not poor - quality. However, with the right processing algorithms the images can be exploited to provide an improved visual feed for navigating, a more accurate record of the cleaning results, and the identification of objects on the hull. All of these will contribute to a more automated cleaning procedure and an autonomously operating machine. Therefore, the focus of this project is the following:

- Real-time enhancement of optical view: develop set of processing algorithms / steps (e.g. shadowing, coloring) for continuously / adaptively improving the quality of the video feed and captured images.
- Automated capturing and classification of images based on quality assessment, location of the robot, and amount of images per ship section. This is used for tracking and reporting of a cleaning operation (automation).
- Detection and recognition of objects on the hull (such as depth marking, holes, anodes, weldlines) for building a ship map and improving the localization of the robot.

FIGURE 1: ROBOT CLEANING ZR. MS KAREL DOORMAN



FIGURE 2: UNDERWATER VIEW OF DEPTH MARKINGS ORIGINAL VIEW (RIGHT) vs. ENHANCED IMAGE (LEFT)



We are looking for a talented and enthusiastic MSc student, preferably with a background in computer vision, image processing, data or related engineering fields. We offer the following:

- 9-12 months thesis assignment at Fleet Cleaner (in the Delft office)
- Actual implementation and testing of your research in a real-world application
- Working in a innovative company with a young, dynamic and multidisciplinary team