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INVESTIGATION OF WEATHER CONDITIONS' INFLUENCE TO THE MARITIME ZONE SURVEILLANCE – GROUND TRUTH GENERATION

Igor Vujović, Ivica Kuzmanić
University of Split, Faculty of Maritime Studies,
Signal Processing, Analysis and Advanced Diagnostics Research and Education Laboratory (SPAADREL),
Ruđera Boškovića 37, 21000 Split
Croatia

ABSTRACT
Various weather condition affects image characteristics: noise is introduce to the image, and general and local illumination values are changed under weather influence. Hence, video surveillance of any traffic can be hard or even impossible. Problems of weather (fog, rain, haze, snow) are not all. There are additional problems specific for water surfaces, such as: wakes, foam, speckles in the water, horizon detection, natural or boat-generated waves on the water surface (sea, lake, or river), waste material floating on the water surface. In outdoor environment, one must not forget camera jitter due to wind and/or vibrations. Problem is also in background modelling due to changes in background geometry, for example caused by anchored boats.
In this paper we investigate possible solution of the ground truth generation in outdoor environments, especially at the sea surface.
Keywords: motion detection, long range, weather conditions, video surveillance

1. INTRODUCTION
Motivation for this research originates from the wish to establish reference dataset for specific purpose, which connects several problems: long range, weather conditions, water surface, and maritime traffic surveillance by video cameras in maritime zones. This is important due to accidents avoidance, monitoring, and/or control. Large ships have AIS to help in this matter, but small yachts, boats and ships do not have such help. Furthermore, small boats and yachts usually do not have radar reflections or there are too little. Hence, video surveillance of the interaction between small-small vessels, and small-large vessels can be performed only by cameras (either video or infrared).
Topic of video background subtraction in various complex environments plays important role in the field of the computer vision [1]. Wish to enhance images, and, consequently, motion detection performance is visible in fact that many references deal with this problem. For example, image enhancement by the super-resolution technique is presented in [2]. Water detection method is presented in [3]. When dealing with real outdoor environments, weather conditions must be considered in performance and reliability analysis of the video surveillance systems. One of the problems is haze. Visibility enhancement in case of haze is covered by, for example, references in [4 – 6]. Foggy weather is discussed in [7]. Video surveillance is also mentioned as a part of hospital information system [8]. It is also used for traffic analysis, such as in [9].
This paper tries to cover some problems in the ground truth generation, as a part of benchmarking of the real maritime situations under various weather conditions.

2. DATASETS
Various datasets are presented up to now. One of them is Labeled dataset for integral evaluation of moving object detection algorithms: LASIESTA [10]. It consists of the original video sequences and the ground truth, in separate images for each frame of the original video. Original videos covers indoor and outdoor scenes, covering various problems. Indoor sequences includes problems of

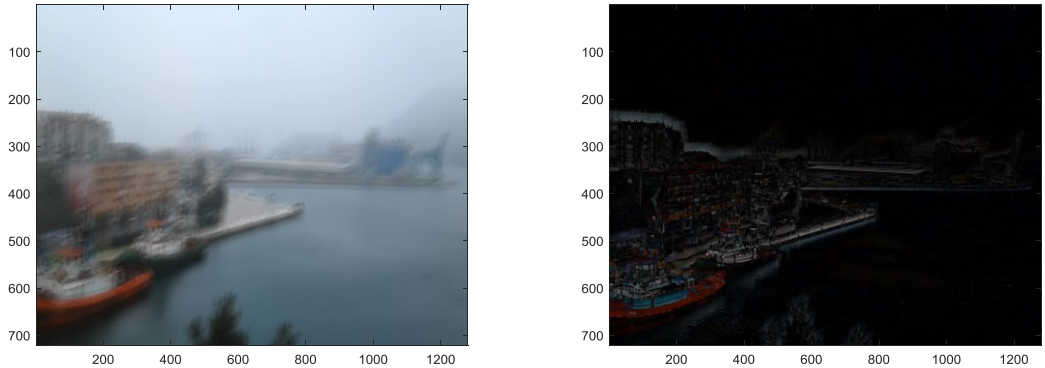
camouflage, occlusions, illumination changes, bootstrap, modified background, and moving camera, as well as simulated motion. The outdoor sequences covers various weather conditions: cloudy, rainy, snowy, sunny, moving camera, and simulated motion. However, maritime situation are not taken under consideration, but road traffic situations.
Change detection dataset [11] covers many outdoor and indoor situations, which are divided into several categories. Each category have several different video sequences.
The FROSI (Foggy ROad Sing Images) database [12]. This database do not cover maritime situations, but road traffic. It contains a set of 504 original images and its ground truth. Motion segmentation benchmark dataset (UdG-MS15) also covers road traffic situations only. There are covered under satisfactory visibility [13].
Maritime detection, classification, and tracking data set [14] is presented in [15]. Sequences cover cases of occlusions, wakes, and reflections, which are real situations at sea surfaces. Electro-optical and infrared cameras were used for this database. Optical cameras were fixed, moving, and pan-tilt-zoom. UCSD Background Subtraction Dataset covers some maritime scenes [16, 17].
Although there are more datasets publicly available, problems are in covering all possible problems that can happen in real situations in case of maritime zone surveillance. Hence, we can conclude that there is a lack of such datasets. We present views regarding scientific project, which is currently going on at our Faculty (see Acknowledgments section).

3. MARITIME ZONE SURVEILLANCE PROBLEMS: RESOLUTION CONSIDERATIONS

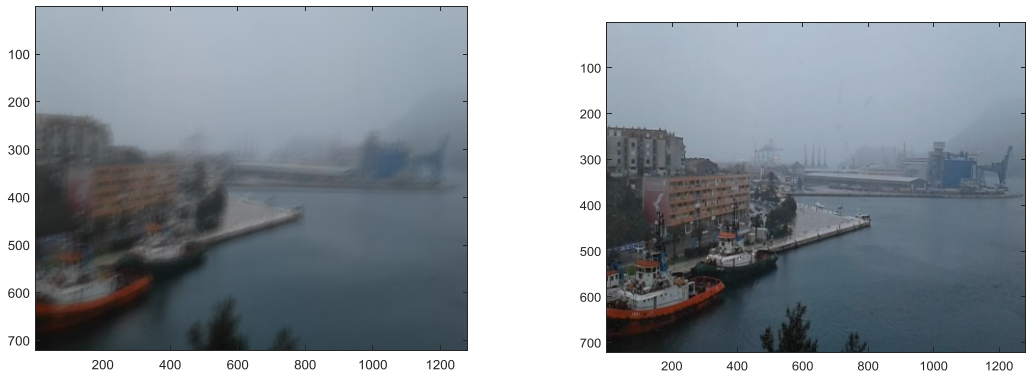
There is the problem in the core of the mentioned datasets: cameras' range. Datasets are usually obtained by standard cameras, which are cheap. These cameras usually produce well quality of the videos. However, range is limitation. Maritime zone is a large space (distance and volume). Standard cameras do not have resolution and range required for useful detection of small objects at high range. There is a real chance to be filtered out small objects (to be considered as noise). In case of methods based on frame averaging, there is a high probability that small objects will be neglected. Hence, high resolution cameras, and special cameras called long range cameras are preferable. However, there are too expensive for small scientific projects. Furthermore, there produce extensive data, which is not practical for web (publicly available datasets are usually in the web). Even standard resolution datasets can be too demanding, such as in [13], which is about 25 GB size.

4. WEATHER INFLUENCE - EXAMPLES

In this section, we present some examples obtained up to date from our scientific project (see Acknowledgments). In case of usual cameras, snowflakes only blur the image. In case of tiny snowflakes, there are even not visible. This weather condition is taken because it is rare at the Adriatic Sea, but it is not un-usual in maritime practice (north seas, or Polar Regions). Figure 1 shows averaged image under snow. Averaging usually removes moving objects. Hence, it is interesting to use it in some automatic ground truth generation algorithm. In case of such weather, the image only gets worse, because of constant position change of snowflakes.



a) *b)*



c) *d)*

Figure 1. Attempts to remove snowflakes: a) by mean of the sequence and renormalization by the maximum value, b) by subtraction of the first frame and the mean frame, c) mean of the sequence without renormalization, d) the example of the original frame

Establishment of mean frame without motion is important in ground truth generation.
Snowflakes are specific and hard to remove, since there are only visible as a contrast to some background colors when using standard resolution cameras (see Fig. 2). It is visible in the contrast to the trees (greens), but not under the road (grays). Sea surface in case of bad weather usually resamples characteristics of grays.

a)

b)

Figure 2. Road camera example: a) arbitrary frame, b) enlarged part with visible snowflake

5. CONCLUSIONS

This paper present the motivation for the new project of authors. There is a need for systematic dataset, which will cover various weather conditions and situations occurring in case of maritime zone surveillance. That is importance of the project.

We can conclude that ground truth generation by averaging to obtain referent background model is not possible due to different weather conditions that influence image quality. Hence, other ways should be found, such as manual labeling, which is work expensive operation.

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