

Temperature Contour Detection of Salt Ice Using Color Thermal Image Segmentation Method

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Abstract : The study uses a novel image analysis based on thermal imaging to detect temperature contours created on salt ice surface during transient phenomena. Thermal cameras detect objects by using their emissivities and IR radiance. The ice surface temperature is not uniform during transient processes. The temperature starts to increase from the boundary of ice towards the center of that. Thermal cameras are able to report temperature changes on the ice surface at every individual moment. Various contours, which show different temperature areas, appear on the ice surface picture captured by a thermal camera. Identifying the exact boundary of these contours is valuable to facilitate ice surface temperature analysis. Image processing techniques are used to extract each contour area precisely. In this study, several pictures are recorded while the temperature is increasing throughout the ice surface. Some pictures are selected to be processed by a specific time interval. An image segmentation method is applied to images to determine the contour areas. Color thermal images are used to exploit the main information. Red, green and blue elements of color images are investigated to find the best contour boundaries. The algorithms of image enhancement and noise removal are applied to images to obtain a high contrast and clear image. A novel edge detection algorithm based on differences in the color of the pixels is established to determine contour boundaries. In this method, the edges of the contours are obtained according to properties of red, blue and green image elements. The color image elements are assessed considering their information. Useful elements proceed to process and useless elements are removed from the process to reduce the consuming time. Neighbor pixels with close intensities are assigned in one contour and differences in intensities determine boundaries. The results are then verified by conducting experimental tests. An experimental setup is performed using ice samples and a thermal camera. To observe the created ice contour by the thermal camera, the samples, which are initially at -20°C , are contacted with a warmer surface. Pictures are captured for 20 seconds. The method is applied to five images, which are captured at the time intervals of 5 seconds. The study shows the green image element carries no useful information; therefore, the boundary detection method is applied on red and blue image elements. In this case study, the results indicate that proposed algorithm shows the boundaries more effective than other edges detection methods such as Sobel and Canny. Comparison between the contour detection in this method and temperature analysis, which states real boundaries, shows a good agreement. This color image edge detection method is applicable to other similar cases according to their image properties.

Keywords : color image processing, edge detection, ice contour boundary, salt ice, thermal image

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