Thermal Image Segmentation Method for Stratification of Freezing Temperatures

Authors : Azam Fazelpour, Saeed R. Dehghani, Vlastimil Masek, Yuri S. Muzychka

Abstract : The study uses an image analysis technique employing thermal imaging to measure the percentage of areas with various temperatures on a freezing surface. An image segmentation method using threshold values is applied to a sequence of image recording the freezing process. The phenomenon is transient and temperatures vary fast to reach the freezing point and complete the freezing process. Freezing salt water is subjected to the salt rejection that makes the freezing point dynamic and dependent on the salinity at the phase interface. For a specific area of freezing, nucleation starts from one side and end to another side, which causes a dynamic and transient temperature in that area. Thermal cameras are able to reveal a difference in temperature due to their sensitivity to infrared radiance. Using Experimental setup, a video is recorded by a thermal camera to monitor radiance and temperatures during the freezing process. Image processing techniques are applied to all frames to detect and classify temperatures on the surface. Image processing segmentation method is used to find contours with same temperatures on the icing surface. Each segment is obtained using the temperature range appeared in the image and correspond pixel values in the image. Using the contours extracted from image and camera parameters, stratified areas with different temperatures are calculated. To observe temperature contours on the icing surface using the thermal camera, the salt water sample is dropped on a cold surface with the temperature of -20°C. A thermal video is recorded for 2 minutes to observe the temperature field. Examining the results obtained by the method and the experimental observations verifies the accuracy and applicability of the method.

Keywords : ice contour boundary, image processing, image segmentation, salt ice, thermal image