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修士論文

水中音響カメラを用いた入射角及び距離画像推定による
マテリアル分布マップの生成

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Abstract

In recent years, the development of coastal areas through the construction of new urban plans has attracted attention. Machines that can be used underwater have been developed to perform pioneering work such as land reclamation work for establishing airports and undersea tunnels. However, these machines are difficult and dangerous to operate, and only a trained operator can operate them safely. Not only is it difficult to operate, it also creates turbidity in the water, making it even more dangerous. Therefore, there is a need for remotely operated underwater robots. Visibility is required for remote control in a murky underwater environment. By using an underwater acoustic camera, turbidity can be ignored. A technology has been developed to understand the underwater environment using acoustic cameras. However, it is not possible to know the details of the object. Therefore, I aim to recognize materials using acoustic cameras.

There are examples of research using deep learning to recognize materials using acoustic cameras. However, it has been impossible to recognize many types of materials. This is because we only using with luminance images taken from acoustic cameras. In order to recognize many types of materials, I propose the construction of a system that recognizes materials in acoustic images by estimating the angle of incidence on the object from the object's shape information and distance information obtained from underwater acoustic images. In addition, a material distribution map is generated based on images with recognized materials so that the underwater environment can be easily understood.

The proposed method consists of two parts. The goal of the first part is to generate an image with added information. The goal of the second part is to use deep learning to recognize many types of materials and improve accuracy.

My method generates images with additional information from the acoustic camera alone, without using any other sensors. we obtain the object's shape information and distance information from the luminance image obtained from the acoustic camera, and derive the angle of incidence at which the sound wave enters the object. Hough transformation is using to obtain shape information. After that, an RGB image is generated by adding luminance information to the R layer, incident angle information to the G layer, and distance information to the B layer. Materials are recognized by inputting RGB images into a semantic segmentation learning model based on deep learning.

In order to confirm the effectiveness of the proposed method, we conducted an experiment in a simulation environment. We created an environment where it is easy to obtain shape information and an environment that imitates reality where it is difficult to obtain shape information. The results revealed that the accuracy of shape information is related to the accuracy of material recognition. If the error

in shape information was within 11 ° , this method showed higher accuracy than the method of inputting luminance images to deep learning. We also showed that the learning trajectory is more stable and generalizable than a method that uses only luminance images. From the above, I have shown that my proposed method is effective.

A material distribution map was generated based on the image in which the material was recognized using the proposed method. This made it possible to reproduce the underwater environment with material information taken into account.