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NEURAL NETWORK BASED SPACECRAFT RECOGNITION FROM SMALL TARGET IN MULTISPECTRAL IMAGE

Abstract

It has great application value for a spacecraft to have the ability to recognize other spacecrafts in orbit. It's also a very challenging problem, because the target spacecraft captured through image sensor boarded on the spacecraft on the orbit usually very small, a target spacecraft even only occupies one pixel in the most of the time. It's hard to recognize the type of spacecrafts even for human. In this paper, we proposed a neural network based spacecraft recognition method to address this challenging problem. Since it's impossible to recognize spacecraft through the appearance of that spacecraft in the image, instead of appearance, we build a neural network with three branches to model three other information of the target spacecraft, respectively. One branch models the surface material of the target spacecraft through the Color Index, which is the magnitude of the target in the three bands. Since different material types have different reflection characteristics in different bands, neural network based on the Color Index is able to predict the surface material of target spacecraft. The second branch models the rotation period of the target spacecraft through the variation of the magnitude of the target. Since the rotation of the target will cause the magnitude of the target to exhibit a periodic change in the image, we build a neural network model on it to predict the rotation period of the target. The third branch models the shape of the target spacecraft based on a hard target shape reconstruction method, which takes the variation of amplitude and the distance of the target as input. Because targets with different shapes will have different magnitude changing patterns when it is rotating, we construct a neural network branch based on the shape reconstruction method to predict the shape of the target. The first branch is modeled with a convolutional neural network. Because the input of the second and third branch is time sequence data, these two branches are modeled with Long-Short Term Memory (LSTM). The output of the three branches are feed to a SoftMax classifier to finally predict the type of the target spacecraft. The whole model is trained and tested with simulation data, the experiment results show the proposed method is able to recognize the type of the target spacecraft, even when the target spacecraft looks like a tiny dot in the multispectral image.