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THEORY AND APPLICATION OF DEEP NEURAL NETWORKS IN FUTURE DEEP SPACE AUTONOMOUS EXPLORATION MISSION

Abstract

AI (artificial intelligence) algorithm and technology has been applied in many aspects of social technology, such as machine vision and intelligent robot. Recently, intelligent sensors, computer vision and natural language understanding (NLU) based on deep learning (DL) help vehicle engineers to finish autonomous driving experiments. Autonomy is a symbolic, essential feature of machine intelligence. and intelligentization, flexibility must be the trend of future space satellites and deep space exploration. Innovative performance of deep learning in robot vision, information processing and humanoid understanding just provide helpful, feasible tools for future satellite system and deep space exploration robots. In computer vision and image processing field deep learning is mainly realized through form of convolutional neural networks (CNN), which is comprised of multiple layers neural networks connected with sparse interaction and parameters sharing. Deep convolutional neural networks with more hidden layers and more complex architectures have more powerful ability of feature representation and feature learning, compared with conventional algorithms in feature extraction such as SIFT or SURF. In this paper, the basic structure of CNN, feature extraction using convolutional and pooling operations are summarized. Taking mission on Mars surface for instance, we proposed a scheme of highly intelligent robot. It has the capacity of terrain detection, target recognition, obstacle position-fix and material search. The DCNN is based on rectified linear unit (ReLU) and padding convolutional layer (PCL) to improve the accuracy of recognition and localization. A trained DCNN in clear dataset is embedded as a feature extractor in a principle-regularized Caffe2 framework, to overcome the limitation of less data in real Martian environment. We expect Mars robots could deal with the environment's complexity and uncertainly by using of DCNN, travel on Mars and carry out scientific tasks. This will bring innovative changes in the field of deep space autonomous exploration.