Application of Deep Learning in Intelligent Ship Direction

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Abstract

This paper mainly introduces the application of deep learning in intelligent ships. Firstly, the development of deep learning and the main network structures, convolution neural network, confidence neural network and cyclic neural network, are introduced. Then the development of intelligent ships is introduced. Finally, the application of deep learning in intelligent ship is introduced.

Keywords

Deep learning, intelligent ship, application, neural network.

1. Introduction to deep learning

1.1 Introduction

Deep learning is a branch of machine learning and a new field in machine learning research. It is the most popular and cutting-edge research content in the AI field. The concept of deep learning was proposed by Hinton et al. in 2006 and stems from the study of artificial neural networks. It is a neural network dedicated to researching simulations and building human brains for analytical learning, analyzing data by mimicking the mechanisms of the human brain. These data include information such as text, sound, and images. As with machine learning methods, in-depth machine learning methods also have the distinction between supervised learning and unsupervised learning. The learning models established under different learning frameworks are very different. Deep learning of perceptrons with multiple hidden layers. By analyzing and learning the underlying features of the data, we can obtain more abstract hidden features and distributed rules of data, so that we can predict the development of things or classify the data.

1.2 Development of deep learning.

In 1943, Neuroscientist W.McCulloch and mathematician W.Pitts established the Neural Network and Mathematical Model (MCP Model) in their paper "Logical Calculus of Inner Thoughts in Neural Activities". The model is an abstract simplified model based on the structure and working principle of biological neurons, which is the origin of artificial neural networks. In 1949, the Canadian psychologist Donald Herb proposed the Hebb Rule, a rule based on unsupervised learning. The haber learning rules are consistent with the "conditional reflex" mechanism, which lays the foundation for the neural network learning algorithm. In 1958, computer scientist Sunblatt proposed a "perceptron" that improved the need to manually set weights in the MCP model, making it more reasonable to set weights and automatically updating settings. The discovery of the perceptron set off the climax of the first neural network. However, the good times did not last long. In 1969, the artificial intelligence pioneer Marvin Minskyzhengming proved that the perceptron can only deal with the linear classification problem, the application range is limited, and the artificial neural network research has fallen into a state of stagnation for 20 years. Until 20 years later, Geoffrey Hinton, the father of neural networks, proposed the BP algorithm, which solved the wave of nonlinear classification and learning, which brought the second wave of neural networks. In the 1990s, the BP algorithm was found to have the problem of gradient disappearance, which also directly hindered the further development of deep learning. Until 2006, Professor Hinton solved the problem of the disappearance of BP neural network algorithm gradient and opened up the wave of deep learning in academia and industry. In 2011, the ReLU activation function was proposed, which can effectively suppress the gradient disappearance

problem. In 2012, in order to prove the potential of deep learning, the Hinton team participated in the ImageNet image recognition competition for the first time. It won the championship through the construction of the CNN network AlexNet and crushed the classification performance of the second (SVM method). Since then, the idea of deep learning has received wide attention from researchers in the industry. In 2016, Google developed the AlphaGo program based on the deep learning algorithm, which defeated the top players in the world of Go, and made the world's attention and shock. Artificial intelligence has become the hottest research field in the IT Internet field, and deep learning has been widely used. Application to various fields.

1.3 Deep learning method

1.3.1 Convolutional Neural Network (CNN)

Convolutional neural network is a deep feedforward artificial neural network. Neurons can respond to surrounding units for large-scale image processing. The network avoids complex pre-processing of images and can directly input original images. Therefore, pattern recognition, Image processing is very widely used. The biggest advantage of convolutional neural networks is local perception and weight sharing. Since the spatial connection of the image is local, each neuron does not need to feel the whole image, only need to feel the local features, and then combine the different local neurons obtained by these feelings at a higher level to obtain a global The information is gone. This will reduce the number of connections. The shared weight is that when extracting features, multiple neurons share a set of weights, and a convolution kernel is used to convolve the images, so the network can learn in parallel. Local perception and value sharing greatly reduce the number of parameters, make the network structure simpler and the training process more efficient.

1.3.2 Deep Neural Network (DBN)

The deep confidence network is a probability generation model, which is mainly divided into two parts. The first part is a multi-layer Boltzmann perceptron for pre-training our network. The second part is the feedforward back propagation network, which can make the RBM stacked network more refined. Improve model classification performance. The system DBN is structurally composed of an unsupervised network and a restricted Boltzmann machine stack. The data is transmitted from top to bottom. The output of the lower layer RBM is used as the input of the higher layer RBM. RBM is composed of visible layer and hidden layer, and the layers are connected by weights. This layer-by-layer transmission method makes the feature expression ability stronger and stronger.

The components of the DBN are Restricted Boltzmann Machines (RBM). Restricted Boltzmann Machine (RBM) is a random generation neural network structure. The restricted Boltzmann machine is a training model based on contrast divergence. During network training and use, the data flows between the explicit unit and the recessive unit, and the weights of the two units are the same, but offset. The values are different. DBN has a wide range of applications and can be applied to handwriting recognition, speech recognition and image processing in machine learning.

1.3.3 Recurrent Neural Network (RNN)

Recurrent Neural Network (RNN) is a kind of neural network with short-term memory ability. In a circulating neural network, neurons can not only receive information from other neurons, but also accept their own information to form a network structure with loops. That is to say, the nodes between the hidden layers of the cyclic neural network are connected, and the input of the hidden layer includes not only the output of the input layer but also the output of the hidden layer at the previous moment. The primary use of circulating neural networks is to process and predict sequence data.

Cyclic neural networks are mainly used in speech recognition, traffic prediction, natural language processing and so on.

2. Introduction of Intelligent Ships

2.1 Introduction

Intelligent ship refers to the application of computer technology, big data analysis technology, automation and so on to navigation, management, transport users and other aspects of the ship. Through the use of the Internet, sensors, communications and other technical means, to automatically perceive and obtain data and information of the ship itself and the outside world, and use various high-tech to analyze and process data, so as to achieve the purpose of safe navigation, more efficient and environmental protection.

Here "intelligence" can be understood as "thinking", which can take into account the specific tasks and various information acquired, and formulate a series of optimal decisions that meet the requirements of ship navigation safety, economy and environmental protection. The functions of intelligent ships can be divided into five aspects: intelligent navigation, intelligent hull, intelligent engine room, intelligent energy efficiency management and intelligent cargo management.

2.2 Development of Intelligent Ships

In recent years, intelligent ships have become a new hotspot in the international maritime community. The International Maritime Organization (IMO) has listed smart ships as an important topic and is carrying out research on relevant laws and regulations; the International Organization for Standardization (ISO) has launched the work of "road map for standardization of smart shipping"; major international classification societies have issued regulations or guidance documents on smart ships successively; and the owners of Japan, Korea and the European Union, etc. Shipbuilding countries are vigorously promoting the development and application of intelligent ships. Generally speaking, the global intelligent ship is still in the initial stage of exploration and development. There is no consensus on the definition, classification and classification of intelligent ship. The research on relevant international maritime conventions and regulations has just started. The core technologies such as intelligent perception have not yet been broken through. The standard system, test and verification system of intelligent ship have not been established. Intelligence has not yet been established. The application of technology engineering is very limited. China's shipbuilding industry and shipping industry have made useful explorations in the field of intelligent ships. Relevant scientific research has made positive progress. The application of intelligent technology engineering has achieved initial results. It has formed a certain technological accumulation and industrial foundation, and basically keeps pace with the international advanced level.

On December 5, 2017, Dazhi, a 38 800-ton intelligent bulk carrier developed by China Shipbuilding Industry Group Corporation, was officially launched at the Shanghai Maritime Conference. Meanwhile, China Intelligent Ship Innovation Alliance was formally established. With the rise of in-depth learning and the improvement of ship automation, intelligent ships have become one of the future directions of global shipping development.

3. Application of in-depth learning in the field of navigation

3.1 Intelligent Operation and Maintenance of Ships

In ship intelligent maintenance, the large data analysis method supporting intelligent ship can be used, and combined with a large number of real ship operation and maintenance data sources, a dynamic decision tree model based on equipment degradation mechanism can be constructed to predict the decline process of ship equipment[1]. In order to realize the ship's equipment detection and intelligent maintenance in navigation, the centralized analysis ability of big data, the integrated management ability of database and 3D visualization technology are combined to realize the ship's intelligent management.

3.2 Ship Recognition Method

In ship recognition, the depth convolution neural network algorithm is used to extract the depth features of ship images[2]. At the same time, combined with HOG algorithm, HSV algorithm and SVM classifier are used to extract the edge features, color features and classify ships.

3.3 Ship Radiated Noise Recognition

In this paper, a deep learning method for ship radiated noise recognition is adopted[3]. Firstly, the spectrum and Meier cepstrum coefficients of ship radiated noise are extracted. The extracted image samples are used to train the neural network and the depth confidence network respectively, and then the ship radiated noise is recognized.

3.4 Container Stereo Recognition and Location Technology

In order to meet the research requirements of container stereo recognition and location, FasterR-CNN is used to identify containers and binocular vision is used to locate the depth of containers. An image object based on GrabCut segmentation algorithm can also be designed[4].

Semi-automatic marking method can segment the foreground and background of the target accurately to produce large-scale container data sets quickly.

3.5 Ship tracking

In ship tracking, convolution neural network and "off-line + on-line + particle filter" can be used for target tracking[5]. The feature classification results obtained by the training of neural network are better and more expressive, so it can be well applied to the feature extraction stage of target tracking.

3.6 Intelligent recognition of ship water gauge

By using image processing technology[6], machine vision technology and deep learning method based on neural network, ship draft line, scale line and scale value can be located and recognized in video or image.

4. Conclusion

Deep learning is proposed and developed on the basis of the development of computer hardware and software and neural network. This paper outlines the principles of CNN, DBN and RNN, which are three key algorithms. Deep learning has been applied to the operation and maintenance of intelligent ships, ship flow forecasting and ship identification. Intelligent ship integrates modern information technology and artificial intelligence. It is safe, reliable, energy-saving, environmental protection, economic and efficient. With the rise of in-depth learning and the improvement of ship automation, intelligent ship has become one of the future directions of global shipping development.

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