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MODELING OF EQUIPMENT AND PARTS USING MACHINE LEARNING

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Abstract

The main machine learning algorithms that can be used in the process of modeling equipment and parts are presented. The scientific novelty lies in determining ways to increase the efficiency of product modeling using machine learning methods. Neural networks are considered one of the most popular algorithms in the field of big data processing. Two basic directions of using neural networks in image recognition are described: classification and regression. The method of step-by-step modeling of 3-D objects used in Image recognition (classification) is presented. Examples of neural networks that generate images based on the Latin and Cyrillic alphabets are given. It is proven that the presented approach allows companies to optimize the process of generating parts. These approaches are at the stage of initial implementation in practical activities since it is not always possible to accurately create visualizations based on a text description.

Keywords:

Machine Learning, Modeling, Neural Network, Optimization, Image Recognition.

Machine learning approaches are promising areas of use in the creation of materials with new properties and innovative parts and products. Thanks to the use of simulation approaches, it is possible to significantly reduce the cost of time and money resources, which contributes to the optimization of research and development activities and the production process. Three main types of machine learning algorithms are used to create graphic objects:

1. Supervised learning.
2. Unsupervised learning.
3. Reinforcement learning.

In the process of implementing machine learning methods, various algorithms are implemented, but neural networks have gained the greatest popularity at this stage of science development. There are two main directions of using neural networks in image recognition: classification and regression. They are:

I. Classification (Image recognition (classification). Image classification with localization. Object detection. Object (semantic) segmentation. Instance segmentation).

II. Regression (Influence of factors. Forecasting. Associative rules).

The process of using graphic objects as a valuable source of information for building effective neural networks involves performing a set of stages, the first of which is the conversion of photo content into digital form. The existing image can be converted into a 2D function F (x, y), where x and y are coordinates in space. A digital image represents the amplitude of F with finite values of x and y. The image can also be converted into a 3D function with spatial coordinates x, y, and z, the presented graphic object is called RGB (Red, Green, Blue) [1]. It should be noted that the use of the RGB color space has disadvantages since it is not possible to separate color information from other data. The use of the RGB approach for image conversion negatively affects the speed of neural network implementation, since it is necessary to use information about 3 channels in the modeling process. An alternative approach involves the use of the HSV (Hue, Saturation, Value) color space.

The main image processing algorithms are Morphological Image Processing, Gaussian Image Processing, Fourier Transform in image processing, Edge Detection in Image Processing, Wavelet Image Processing, and Image processing using Neural Networks.

Neural networks are multilayer networks that are created from the basic units of data processing in the system (neurons or nodes).The operation of a neural network in the image-processing process is based on the following principles:

1. The image is divided into pixels, and a separate pixel acts as a neuron of the first layer.

2. Each channel is given a weight in the form of a probabilistic numerical value.

3. Weighted sums are calculated as the multiplication of the weights by the corresponding input data, and the result is used as an input to the hidden layers of the neural network.

4. The selected activation function is applied to the output data, making a decision on whether to activate the neuron or refuse further actions.

5. Data propagation to subsequent layers of the network occurs only due to acti-vated neurons.

6. The layer's output neuron is the highest probability value.

7. The error is calculated as the difference between the predicted and actual out-put. Thanks to backpropagation, the results are transmitted back through the net-work.

8. A certain number of iterations of forward and backpropagation of data are per-formed with gradual adjustment of the weights. When the optimal value is reached, the neural network stops the learning process.

In recent years, multimodality approaches have gained significant popularity in the field of machine learning, which involves building models using images, text, voice, and audio content simultaneously. The OpenAI Artificial Intelligence Research Laboratory introduced the public to the DALL-E neural network, which allows the creation of images with a size of 256x256 pixels based on a text description [2]. The limitations of this approach are explained by the fact that the neural network is trained based on an English-language description. Chinese scientists have developed their CogView neural network [3], which in certain parameters has surpassed the results of the OpenAI organization. Developing the presented concept, specialists have built their neural models that allow the generating images based on a Cyrillic text description.

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МОДЕЛЮВАННЯ ОБЛАДНАННЯ ТА ДЕТАЛЕЙ З ВИКОРИСТАННЯМ МАШИННОГО НАВЧАННЯ

Анотація

Представлено основні алгоритми машинного навчання, які можуть бути використані в процесі моделювання обладнання та деталей. Наукова новизна полягає у визначенні шляхів підвищення ефективності моделювання виробів за допомогою методів машинного навчання. Нейронні мережі вважаються одними з найпопулярніших алгоритмів у сфері обробки великих даних. Описано два основні напрямки використання нейронних мереж у розпізнаванні зображень: класифікація та регресія. Представлено метод покрокового моделювання 3D-об'єктів, що використовуються в розпізнаванні зображень (класифікації). Наведено приклади нейронних мереж, що генерують зображення на основі латинського та кириличного алфавітів. Доведено, що представлений підхід дозволяє компаніям оптимізувати процес генерації деталей. Ці підходи знаходяться на стадії початкового впровадження в практичну діяльність, оскільки не завжди можливо точно створювати візуалізації на основі текстового опису.

Ключові слова:

Машинне навчання, моделювання, нейронна мережа, оптимізація, розпізнавання зображень.

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