بسم الله الرحمن الرحيم

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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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Improving Convolutional Neural Networks Learning Through Adaptation

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Abstract

Recently, Convolution Neural Network (CNN) has accomplished great success in numerous issues of machine learning. Many machine learning methods have been developed for such objectives, for example, Artificial Neural Network (ANN), logistic regression, Support Vector Machine (SVM), deep learning, etc.

Deep learning (specifically CNN) is one of the strategies by which can delude the challenges of the feature extraction process. Usually, deep learning models are capable of extracting the proper features by themselves. Also, deep CNN models are usually designed manually and the key parameters of it are decided by experience and repeated tests which incredibly limit the applications of deep CNN.

Therefore, it is a great challenge to design the proper deep CNN model and reduce the dependence on manual involvement and expertise. So, this thesis will discuss the improvement of the convolution neural network design from different aspects with various methods. The CNN improvements include how to automatically design CNN model without operator intervention, change on convolution or pooling layers, adding some features to save the computational resources, and how to use adaptive and optimized CNN parameters.

On the other side, many hyper-parameters of the CNN can affect the model performance. These parameters are depth of the network, numbers of convolutional layers, numbers of kernels with their sizes. Therefore, it may be a huge challenge to design an appropriate CNN model that uses optimized hyper-parameters.

In this thesis, a design architecture method for CNNs is proposed by utilization of Particle Swarm Optimization (PSO) algorithm to learn the optimal CNN hyper-parameters values.

In the experiment, MNIST (Modified National Institute of Standards and Technology) database of handwritten digit recognition was used. The experiments appear that the proposed approach can find an architecture that is competitive to the state-of-the-art models with a testing error of 0.87%.

List of Publications

1. Zainab Fouad, Marco Alfonse, Mohamed Roushdy and Abdel-Badeeh M. Salem, “Improving the Design of Convolution Neural Network Architecture: Enhancement Methods, Applications and Challenges”, proceeding of the 10th International Conference on Applied Internet and Information Technologies AIIT 2020, pp. 289-295. (Indexed in Scopus)

2. Zainab Fouad, Marco Alfonse, Mohamed Roushdy and Abdel-Badeeh M. Salem, “Hyper-parameter optimization of convolutional neural network based on particle swarm optimization algorithm”, Journal of Bulletin of Electrical Engineering and Informatics, Vol 10, No 6: December 2021, pp. 3377-3384. (Indexed in Scopus)

3. Zainab Fouad, Marco Alfonse, Mohamed Roushdy and Abdel-Badeeh M. Salem, “Survey of Convolutional neural network hyper-parameters optimization methods”, International Journal of Intelligent Computing and Information Sciences. (Accepted)

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List of Abbreviations

Abbreviation	Definition
ABC	Artificial Bee Colony
ACNN	Adaptive Convolutional Neural Network
ACO	Ant Colony Optimization
ADCNN	Adaptive Deep Convolutional Neural Network
AFSO	Artificial Fish Swarm Optimization
ANN	Artificial Neural Network
BA	Bat Algorithm
BFO	Bacterial Foraging Optimization
CGP	Cartesian Genetic Programming
CNN	Convolutional Neural Network
DPSO	Distributed PSO
FA	Firefly Algorithm
GA	Genetic Algorithms
HBMO	Honeybee Mating Optimization
HDNN	Hybrid Deep CNN
HENet	Highly Efficient Convolutional Neural Networks
HORD	Hyper-Parameter Optimization via RBF and Dynamic coordinate search
LDWPSO	linearly decreasing weight PSO
MAE	Mean Absolute Error

MINST	Modified National Institute of Standards and Technology
ML	Machine Learning
MSE	Mean Square Error
NIN	Network in Network
NMM	Nelder-Mead Method
PSO	Particle Swarm Optimization
RBF	Radial Basis Function
ReLU	Rectified Linear Unit
SaCNN	Scale adaptive CNN
SI	Swarm Intelligence
SVM	Support Vector Machine