

# [DL] A Survey of FPGA Based Neural Network Accelerator

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Recent researches on neural network have shown great improvement in computer vision over traditional algorithms based on handcrafted features and models. Neural network is now greatly adopted in regions like image, speech and video recognition. But the great computation and storage complexity of neural network based algorithms poses great difficulty on its application. CPU platforms are hard to offer enough computation capacity. While GPU platforms are highly parallelized, the energy efficiency is low. The high energy cost of GPU causes problems for a wide application of neural network.

To address the above problems, various FPGA based hardware accelerators for neural networks have been proposed. Specialized hardware are designed to achieve high speed and low power neural network process. In this paper, we give an overview of previous work on neural network accelerators based on FPGA and summarize the main techniques used. Investigation from software to hardware, from circuit level to system level is carried out to complete analysis of FPGA based neural network accelerator design and serves as a guide to future work.

Additional Key Words and Phrases: FPGA, Neural Network

## ACM Reference Format:

Kaiyuan Guo, Shulin Zeng, Jincheng Yu, Yu Wang AND Huazhong Yang. 2017. [DL] A Survey of FPGA Based Neural Network Accelerator. *ACM Trans. Reconfig. Technol. Syst.* 9, 4, Article 11 (December 2017), 2 pages. <https://doi.org/0000001.0000001>

## 1 INTRODUCTION

Recent research on Neural Network (NN) is showing great improvement over traditional algorithms in computer vision. Various network models, like convolutional neural network (CNN), recurrent neural network (RNN), have been proposed for image, video, and speech process. CNN [] improves ImageNet [] classification accuracy from xxx% to xxx% and further helps improve object detection [] with its outstanding ability in feature extraction. Long short-term memory (LSTM) [], a variety of RNN, reduces the word error rate of speech recognition from xxx% to xxx%. In general, NN features a high fitting ability to a wide range of pattern recognition problems. This makes NN a promising candidate to many artificial intelligence applications.

But the computation and storage complexity of NN models are high. The research on NN is also increasing the size of NN models. The largest neural network model for an  $224 \times 224$  image classification requires upto 39 billion floating point operations and more than 500MB model parameters [].

1. Traditional platforms are not good enough for NN process.
2. FPGA benefits from its great flexibility and is a good candidate. a wide range of FPGA servers have been
3. software design

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1936-7406/2017/12-ART11 \$15.00

<https://doi.org/0000001.0000001>

4. hardware design
5. brief summary
6. paper organization