Karlsruher Institut für Technologie

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Unser Zeichen:
Datum: 07.03.2018

Bachelor/Master-Thesis

Deep-Learning Convoluted Neural Networks for Automated Optical Inspection of Power Electronic Systems

Power electronic systems using SiC-MOSFETS can be operated at much higher temperatures than systems comprising standard silicon IGBTs. This might cause high thermal and mechanical stress in the power module. Hence, new interconnect technology based on low temperature silver and copper sintering processes as well as innovative double-side cooled power modules are developed at the Institute for Data Processing and Electronics (IPE). However, during operation or already in production steps the modules might break. The assessment of the root failure is done through ultra-sound image inspection.

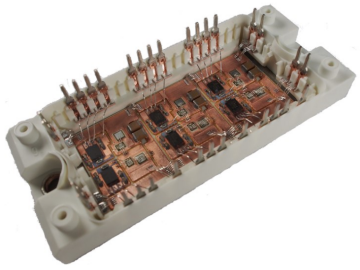

Fig. 1: Highly integrated SIC power module

During the past 5-10 years Deep Learning Convoluted Neural Networks (CNN) were developed, tailored for automated pattern recognition and feature extraction for medical and other purposes. The quality of the automated feature extraction is very high. Hence, CNN methods are likely to be successfully utilized in automated quality inspection for electronic systems as well.

Task

In the thesis, CNN methods implemented in MATLAB® shall be developed and evaluated for automated quality detection of power electronic substrates. The input data („pictures“) of the substrates is generated by an advanced ultra-sound Scanning Acoustic Microscope (SAM). Our industrial collaboration partners provide a picture sample library, which shall be augmented by new Images and, which can be acquired with the SAM of the institute. Specific power modules with well-defined defects shall be prepared and used to demonstrate to robustness of the parametrized CNN.

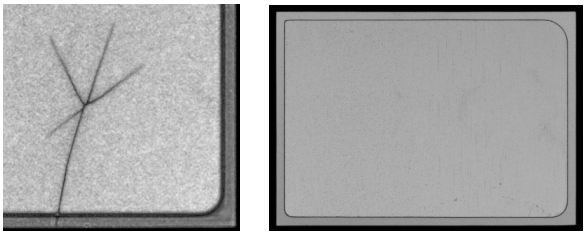

Fig. 2: Enlarged crack in a substrate (left), fully functional substrate (right)

You should:

- Summarize the state of the art of CNN-algorithms
- Propose a network suitable for the pattern recognition tasks
- Implement the network under MATLAB
- Train and validate the network
- Develop methods to run the CNN using the GPU capabilities of MATLAB
- Propose methods to run the algorithms natively on GPUs

Your background

You study electronic or mechanical engineering or computer science with a strong engineering and computational background. You have good programming skills in MATLAB and some background in neural networks. Additionally, you have strong analytical skills and the motivation to solve challenging technical tasks.

Contact

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