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Zooming radiography with less artifacts using convolutional neural networks

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In non-destructive x-ray inspection of a printed circuit board (PCB), the field of view (FOV) is usually small because of the application of high magnification into radiographs, which can help find micro-sized defects in ball-grid arrays or wire bonding parts. Without loss of FOV digital zooming can be applied, but which results in check-board artifacts at some extents of zooming level. Digital zooming with an interpolation may avoid the artifact but image sharpness will be degraded.
We develop a zooming filter or a super-resolution filter using a deep convolutional neural network (CNN). The network consists of several convolution layers, deconvolution layers, and element-wise summation layers. For training the network, the input images are obtained by down-sampling x-ray PCB images while the label images are obtained by applying the Gaussian de-blur kernel to the original images. From the total of 52 images, about 30k patches are extracted for training and validation, and separate 8 PCB images are used to test the network. The preliminary results are shown in Fig. 1. Although the network output image is blurrier than the label image, it is almost free from the check-board artifact and outperforms the bi-cubic interpolation method. We are optimizing the network for various hyper parameters, such as the number of layers and channels in each layer. With the optimized network, the performance will be investigated more quantitatively.

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