Hardware independence and accuracy of neural network denoising of images depending on training set size

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This work is an investigation of image enhancement (increasing exposure and noise reduction) using neural networks proposed in Chen et al. Learning to See in the Dark (2018). The applicability of a neural network trained on the dataset from a camera to images from another camera and possibility to reduce the size of dataset to train neural network for a new camera are analyzed. A dataset of 27 aligned pairs of raw photos was collected with Exposures of 0.01s and 1s. The model trained on dataset of 320 scenes is compared with the model trained on randomly sampled 40 scenes by testing on photos from multiple cameras with the same type of colour filter. Considering the dependence of such quality metrics as PSNR and SSIM on training set size it was concluded that for the size of 25-30 scenes metrics are greater than 90% of the values claimed by the authors of the above-mentioned article for their model trained on 160 scenes. Also these metrics are compared for the model trained on the photos from the first camera, and model trained on new camera photos after their testing on a set of photos from the second camera. Despite the numerical results (PSNR / SSIM = 27.40 / 0.82 for the first and 30.06 / 0.83 for the second model) visual comparison of the quality of the details on the images for the model trained on a relatively large dataset from another camera are markedly better that confirms the cross-sensor generalization of the method of the mentioned article, as claimed by its authors.

Key words: image processing, denoising with neural network, computational photography.