ENHANCEMENT OF ELEMENTAL IMAGING USING RESNET34 BASED UNET WITH PERCEPTUAL LOSS

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Elemental imaging is visualization of the distribution of elements of interest within solid samples. It is widely used across different fields analysing various materials by many analytical techniques. With destructive methods, such as LA-ICP-MS or LIBS, where the sample is ablated by laser beam, spot, by spot, we get pixelated image where the resolution is dependent on the beam size. Decreasing the beam size infinitely is not possible, which leads us to image enhancement by computers.

This research is focused on using advanced neural networks for image improvement, with aim on noise removal and super resolution. Several state of the art architectures were used on different datasets and compared. The training set consisted from ground truth images – the original pictures, and their second version created by virtual ablation, which reduces their quality. Modelling was performed using five consecutive matrix manipulation steps [1]: laser sampling of the sample in the ablation cell; introduction of Flicker noise (mostly associated with pulse reproducibility); aerosol washout from the ablation cell and transfer to the detector; measurement by integrating the counts for a chosen dwell time; introduction of Poisson noise (as a result of counting statistics).

From all tested architectures UNet [2] had the best performance. This deep learning model was build using the fast.ai library. It consists of UNet, where the encoder was created from a pretrained ResNet34 and Perceptual loss combined with a Least Absolute Deviations and gramian function. Enhanced images were compared to the original and ablated version, using 2 metrics: structural similarity index (SSIM) and peak signal-to-noise ratio (PSNR). The results show a promising way in improving imaging, which can lead to cheaper and faster analysis.

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2. Ronneberger, O., Fischer, P. and Brox, T., 2015, October. U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.