Neural networks restore microscopic images

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Skoltech Ph.D. student Valeriya Pronina presented her work on microscopy image restoration at the computer vision conference ECCV 2020. For the idea behind this research, Valeriya was awarded the Ostrogradski scholarship from the French government and invited to conduct a joint research in a laboratory at the Lyon National Institute of

Applied Sciences (INSA Lyon) in France.

Valeriya Pronina's research, under the guidance of Assistant Professor Dmitry Dylov at the Skoltech Center for Scientific and Engineering Computational Technologies for Large Datasets (CDISE), demonstrates how deep Wiener-Kolmogorov filters can be applied to reconstruct microscopy images. The fact is that the quality of images obtained by microscopy of biological objects usually suffers from an excess of noise, and the images are often blurry. This interferes with the adequate perception of the information presented in the image and can lead, for example, to an erroneous diagnosis. The use of deep learning algorithms provides images that are clearer and more noise-free.

Dmitry Dylov says, "In many modern deep learning articles authors try to improve images using somewhat straightforward and 'agnostic' methods. That is, the model uses some data and tries to directly approximate the desired result. In our work, we were inspired by variational and optimization problems, where the apparatus for noise filtering and image restoration is already well studied. Knowing how classical filters work, we used deep neural networks not to clean the images themselves, but to learn the filtering parameters. As a result, Valeriya's model was able to outperform the current models of other researchers."

Valeria Pronina says, "The CREATIS laboratory research team led by Dr. Françoise Peyrin, deals with the study of tomographic images and radiotherapy, as well as inverse problems in medical imaging. They became interested in the developed algorithms for noise reduction of signals on specific laboratory microscopes with a small number of pixels. I am very happy to spend three months of joint research in the CREATIS laboratory and in particular in the group of Françoise Peyrin and apply the developed methods on the most modern microscopes."

The algorithms combine both classical optimization and deep learning methodologies. These approaches are ready for easy tuning and a trade-off between computational efficiency and image recovery accuracy. In the future, we plan to integrate the proposed methods into the general scheme of processing images exposed to blur and noise, and obtained with the help of specific microscopes studied in the laboratory.

More information: Pronina et al., Microscopy image restoration with deep Wiener-Kolmogorov filters. arXiv:1911.10989 [eess.IV]. arxiv.org/abs/1911.10989

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