



Contribution ID: 4

Type: **Talk**

A Note on the Regularity of Images Generated by Convolutional Neural Networks

Thursday, 3 November 2022 15:15 (30 minutes)

Convolutional neural networks (CNNs) are frequently used for image generation, see for instance [1,2]. In this context it has been observed in practice that CNNs have a smoothing effect on images. While this is desirable for denoising it also leads to unwanted blurring of edges. In this talk we formalize this observation by rigorously showing that, under mild conditions, images generated from CNNs are continuous and in some cases even continuously differentiable. In particular this implies that CNNs cannot generate sharp edges which are a key feature of natural images. To prove these results we first consider CNNs in function space for which regularity results can be proven and afterwards show that practically used CNNs are, indeed, proper discretizations of these function space CNNs. Furthermore we provide numerical experiments supporting our theoretical findings and suggest modeling approaches to avoid the issue. See [4] for a preprint of our work.

[1] V. Lempitsky, A. Vedaldi, and D. Ulyanov. Deep image prior. In 2018 IEEE/CVF, Conference on Computer Vision and Pattern Recognition, pages 9446–9454, 2018.

[2] V. Jain and S. Seung. Natural image denoising with convolutional networks. *Advances neural information processing systems*, 21, 2008.

[4] A. Habring and M. Holler. A Note on the Regularity of Images Generated by Convolutional Neural Networks. arXiv preprint arXiv:2204.10588 (2022).

Primary authors: HABRING, Andreas (University of Graz); Dr HOLLER, Martin (University of Graz)

Presenter: HABRING, Andreas (University of Graz)