# RecVis - project proposal: Self-supervised methods for low-level vision

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## 1. Motivations

CNNs are nowadays the dominant approach for image denoising. Several CNNs have been proposed, differing in their architecture and training techniques. Traditionally, the models are trained in a supervised way - starting from a noisy input, a loss between the output and the ground truth clean image is penalized. However, in many cases the acquisition of noisy-clean image pairs may be difficult or even impossible. This has motivated the investigation of self-supervised training methods, learning exclusively from noisy data. A main idea for self-supervised training is to employ blind-spot networks, namely networks who do not have access to the central pixel of the receptive field. [7].

## 2. Plan of work

Models are trained on synthetic datasets. The training dataset uses images from ImageNet. The validation set uses images from Kodak, Set14 and BSD300 datasets. Images from the test set come from the BSD68 dataset. As a first step, an additive gaussian noise with standard deviation of 25 is added to the images. Other models of noises may be processed for the datasets afterwards. Comparisons between algorithms will be based on the peak-signal-to-noise ratio metric as well as visual inspection. We will use checkpoints and models of SSDN, Noise2Void and DnCNN as well as training and validation datasets from a GitHub repository created by D. Jones *et al*. [4]. Models will be compared on synthetic and real noises.

**The chronological steps are :**

1. Read and learn about self-supervised and supervised learning methods for denoising. Investigate technics such as blind spots networks and bayesian model used in Noise2Void and SSDN. (Nathan & Arthur)

2. Training or use of checkpoints of the Noise2Void training introduced by A. Krull *et al*. [5] on noisy images from ImageNet dataset. Test on noisy BSD68 dataset. (Nathan)

3. Same as 2. but with SSDN method introduced by S. Laine *et al*. [6]. (Arthur)

4. Comparison of both training schemes to several denoising methods: DnCNN introduced by K. Zhang *et al*. [10] and its improvement FFDNet [11] coded in [9]; we will finally investigate patches-based algorithms such as BM3D [3] on BSD68 dataset. (Nathan)

5. Same as 4. but the models will be tested on the Darmstadt Noise Dataset which provides real noisy images and corresponding ground truth images that were captured with consumer grade cameras of differing sensor sizes [8]. (Arthur)

6. (optional 1) Adaptation of one of the self-supervised methods to denoise raw photographs in order to run the method on GoPro shots taken in low-light conditions. Unprocessing of the training images to form raw images by sequentially inverting image processing transformations, as described in the paper by T. Brooks *et al*. [2] and coded in [1]. Adaptation of the neural network to process raw images (loss, operation on four channels...). (Nathan & Arthur)

7. (optional 2) Adaptation of one the architectures to another task such as super-resolution.

## References

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