

Noise2Void

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Articles

Noise2Void: N2V - Learning Denoising from Single Noisy Images

- Alexander Krull et. al 2019

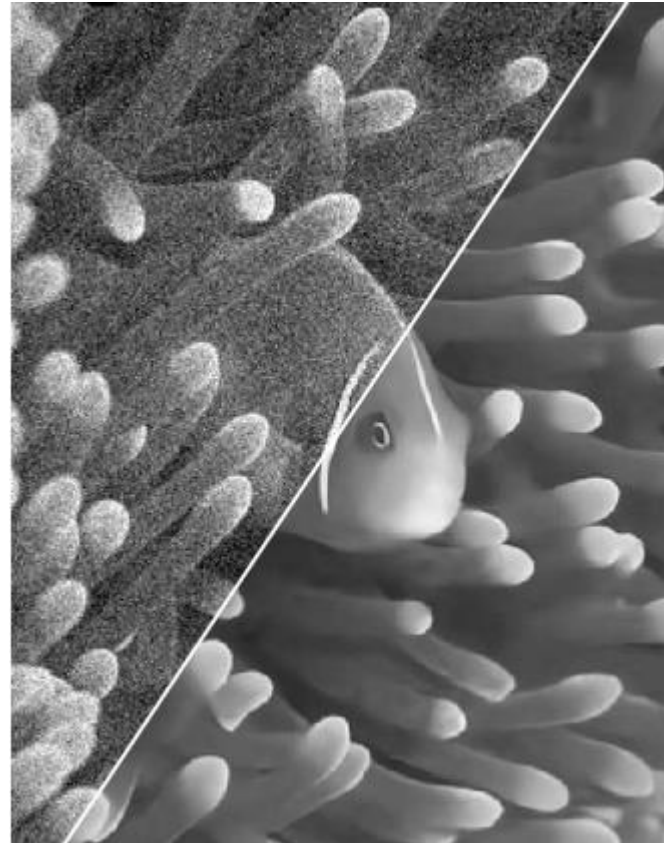
Probabilistic Noise2Void: PN2V - Unsupervised Content-Aware Denoising

- Alexander Krull et. al 2019-2020

The Problem

Image Denoising

The Noisy Image: $x = s + n$

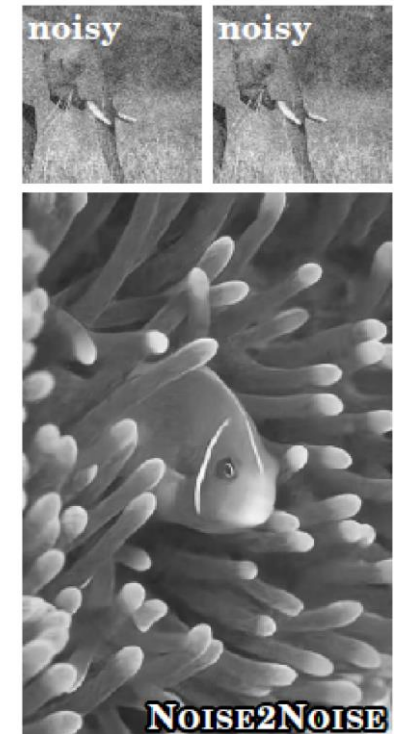
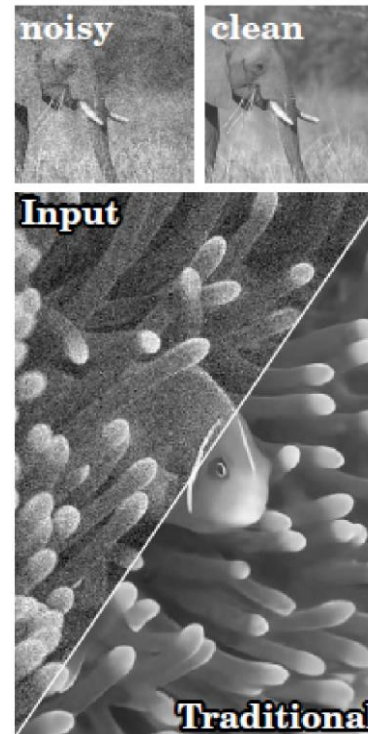


Background /Traditional Methods

* Noisy and Clean Image

* Noise2Noise (N2N)

- CARE
- **Pairs** of mages

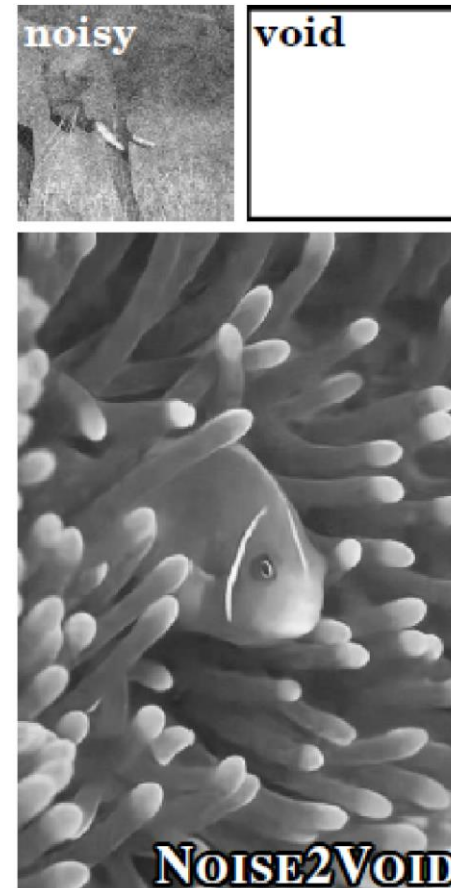


Noise2Void : Motivation

- No pairs !

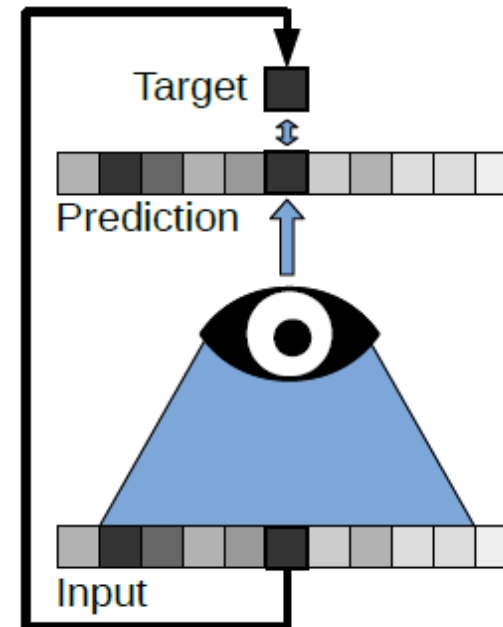
Only single image are available

- Use **Only noisy** images
- Can be applied where **others can't**



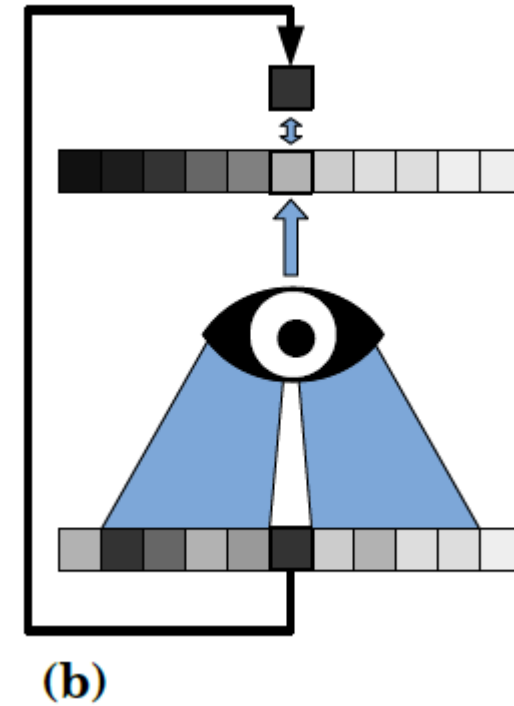
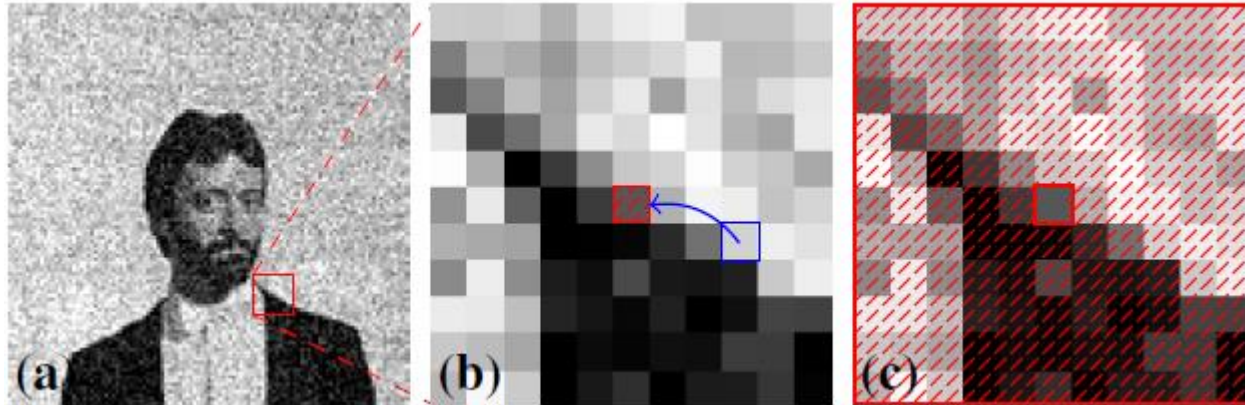
Noise2Void assumptions + term

- The **noise** n is pixel-wise **independent**
- The **signal** s is **not** pixel-wise **independent**
- **Receptive field** ($x_{\text{RF}(i)}$) set of pixels



Noise2Void :Self Supervised Training

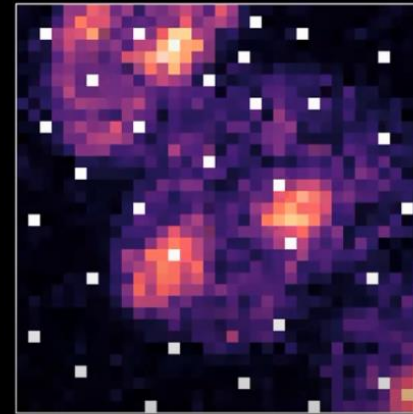
Blind-Spot network using RF



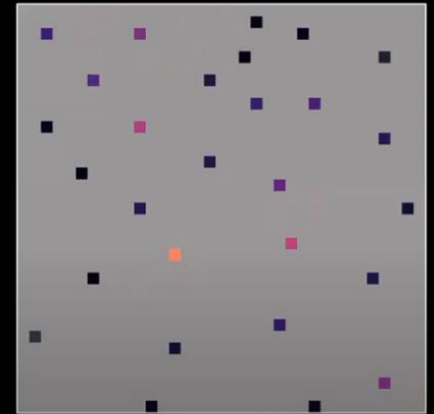
Noise2Void: Implementation

- 64×64 pixels **Random Patches**
- **Replace N pixels** in the **Receptive Field**

Creating Blind Spots



Input



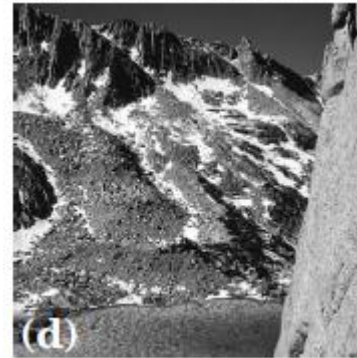
Target

Experiments:

	Ground Truth	Input	Traditional	NOISE2NOISE	NOISE2VOID
BSD68					
cryo-TEM					
CTC-MSC					
CTC-N2DH					

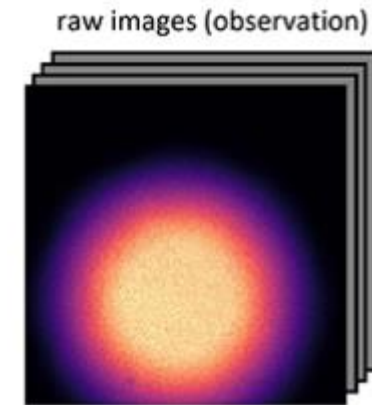
Noise2Void: Limitations

- **pixels very different** from surroundings
- Images with **high error rate**
- pixel-wise independence – **patterns**



The Proposed Method2: Probabilistic Noise2Void

- Similar as Noise2Void
- New Assumption: The **noise model** distribution is know
- Model **Per Hardware**



PNzV:Method

Predict **probability distribution** of the signal:

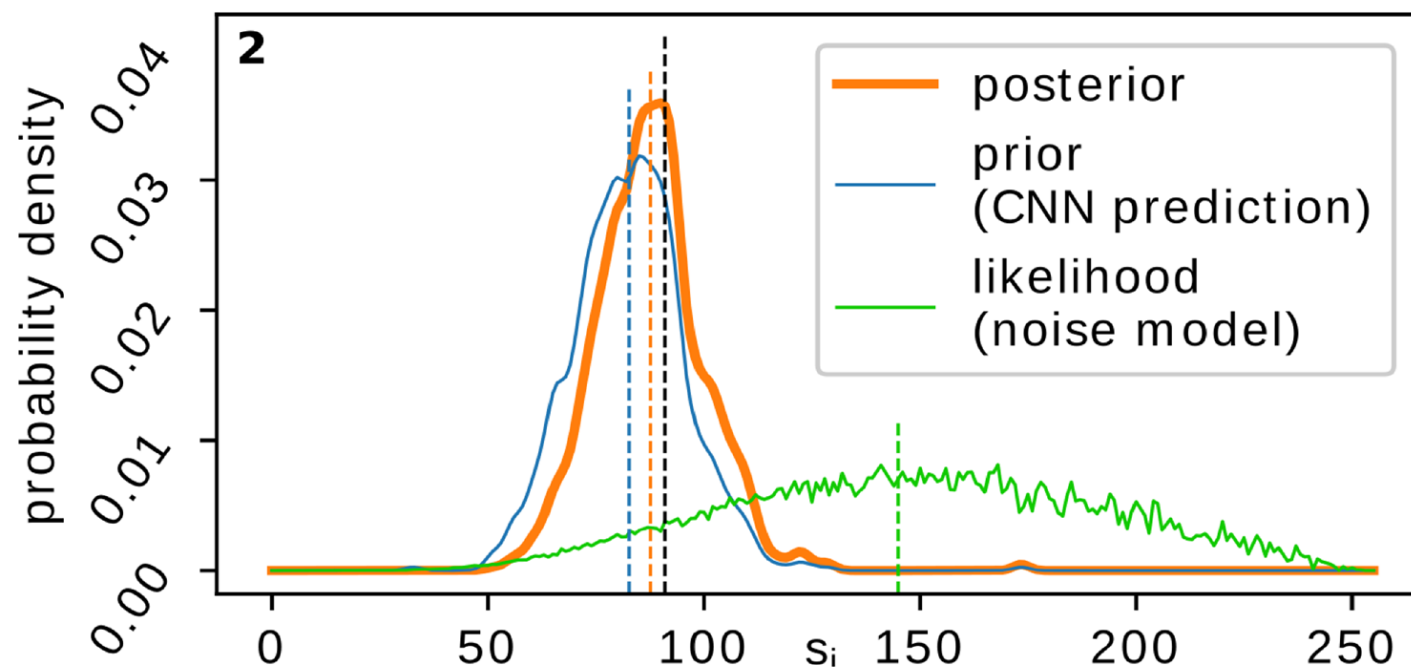
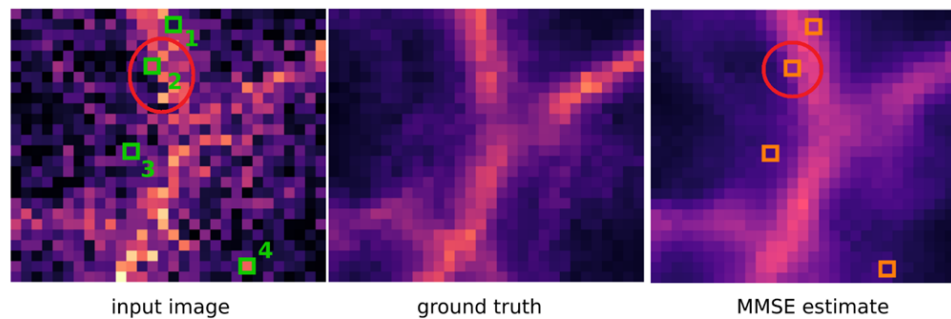
Pixel probability as the signal weight

$K = 800$

MMSE (Minimum Mean Square Error)

$$\mathbf{s}_i^{\text{MMSE}} \approx \frac{\sum_{k=1}^K p(\mathbf{x}_i | \mathbf{s}_i^k) \mathbf{s}_i^k}{\sum_{k=1}^K p(\mathbf{x}_i | \mathbf{s}_i^k)}.$$

Example



Noise2Void + PN2V :Discussion

Pros

- Can be used when other can't
- Very creative idea
- Code available @ <https://github.com/juglab/n2v> (<https://github.com/juglab/pn2v>)

Cons

- Evaluated (with PSNR) only using **simulated data** or **simulated noise**

Limitations / PN2V

- Single Channel
- Calibration Data

Questions

