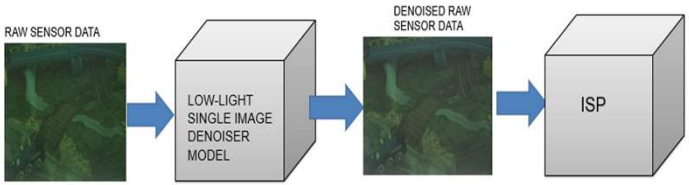
Extreme Low-Light Single-Image Denoising Model

Nikhil Parab
nik17@stanford.edu

Motivation

- Denoising is challenging under low-light conditions for real-time applications due to low photon count, low SNR and single-frame processing timing constraints.
- Goal: Achieve acceptable denoising from single-frame processing under extreme low-light.



Related Work

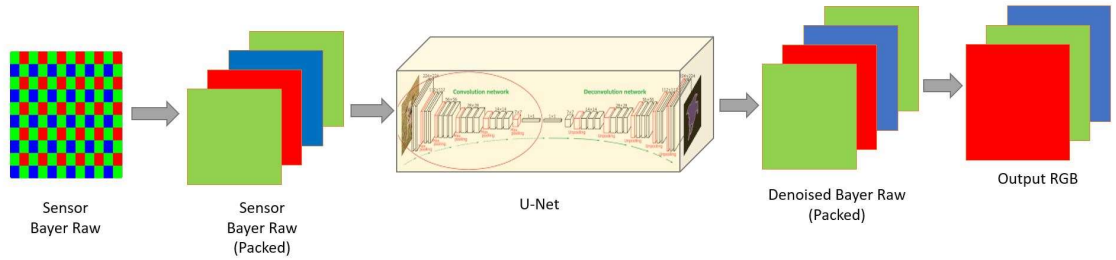
- *Burst Denoising:* Depends on lucky image and requires multi-frame processing.
- *Traditional models like NLM, BM3D*: Requires noise-level specified extrinsically (non-blind) which can be tricky under low-light conditions.
- *Learning to See in the Dark*: Lacks cross-sensor generalization and requires amplification factor as external input.

References

[1] Chen Chen, Learning to See in the Dark, May 2018
[2] Abdelrahman Abdelhamed , A High-Quality Denoising Dataset for Smartphone Cameras
[3] Samuel Hasinoff, Marc Levoy Burst photography for high dynamic range and low-light imaging

New Technique

- Data-driven low-light single-image denoising model [SIDD dataset]
- Fast low-light denoising (single-frame processing)
- Blind denoiser and agnostic to camera sensor



Experimental Results

	Sensor Raw Data + Demosaick + Gamma (output scaled for display)	Sensor Raw Data + Demosaick + NLM + Gamma (output scaled for display)	Sensor Raw + Proposed Model + Demosaick + Gamma (output scaled for display)
0.1s	 PSNR = 17.9239	 PSNR = 21.11	 PSNR = 21.5773
0.1s	 PSNR = 14.9193	 PSNR = 18.95	 PSNR =24.23
0.04s	 PSNR = 20.0664	 PSNR = 23.11	 PSNR = 20.43