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.

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

<table>
<thead>
<tr>
<th>Sensor Raw Data + Demosaick + Gamma (output scaled for display)</th>
<th>Sensor Raw Data + Demosaick + NLM + Gamma (output scaled for display)</th>
<th>Sensor Raw + Proposed Model + Demosaick + Gamma (output scaled for display)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image 1" /></td>
<td><img src="image2.png" alt="Image 2" /></td>
<td><img src="image3.png" alt="Image 3" /></td>
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<td><img src="image4.png" alt="Image 4" /></td>
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<td><img src="image7.png" alt="Image 7" /></td>
<td><img src="image8.png" alt="Image 8" /></td>
<td><img src="image9.png" alt="Image 9" /></td>
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References

[1] Chen Chen, Learning to See in the Dark, May 2018
[3] Samuel Hasinoff, Marc Levoy Burst photography for high dynamic range and low-light imaging