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Image Reconstruction from Neuromorphic Event Cameras using Laplacian- Prediction and Poisson Integration with Spiking and Artificial Neural Networks

Hadar Cohen Duwek **Albert Shalumov** **Elishai Ezra Tsur**

CVPR 2021 Workshop on Event-based Vision

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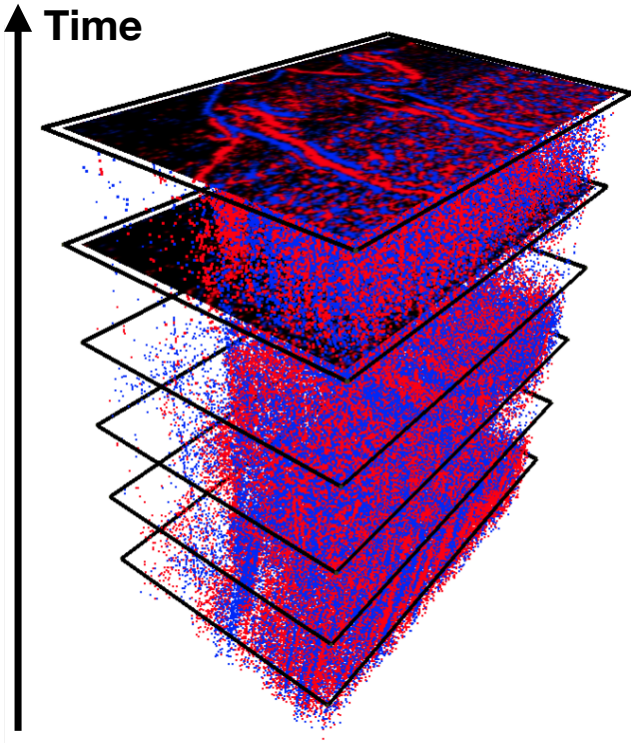
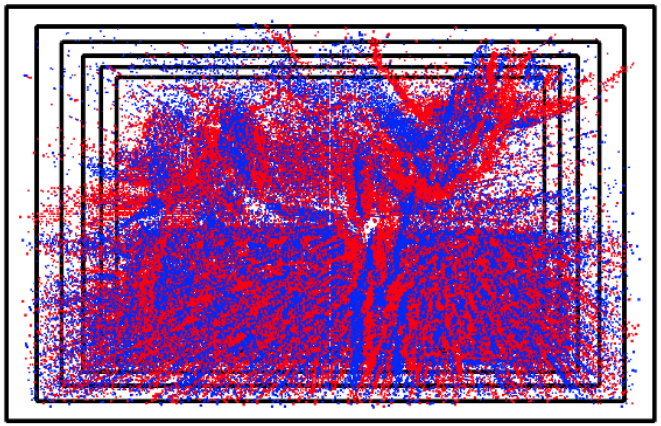
NEURO-BIOMORPHIC ENGINEERING LAB

Neuromorphic Event Camera





- High frame rate
- Fine temporal resolution
- High dynamic range
- No motion blur
- High signal-to-noise ratio.

Image Reconstruction

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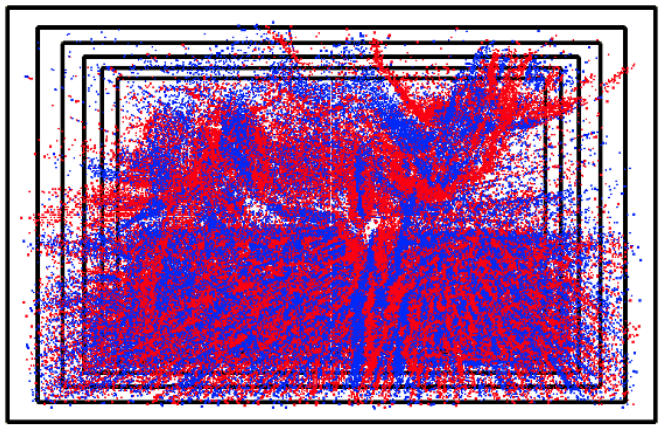

Convolutional Neural Network

- Large parameter space
- Non-spiking

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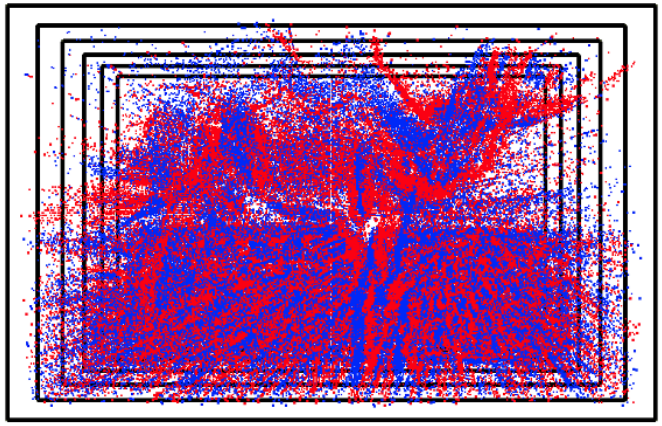

Convolutional Neural Network

Laplacian's Prediction

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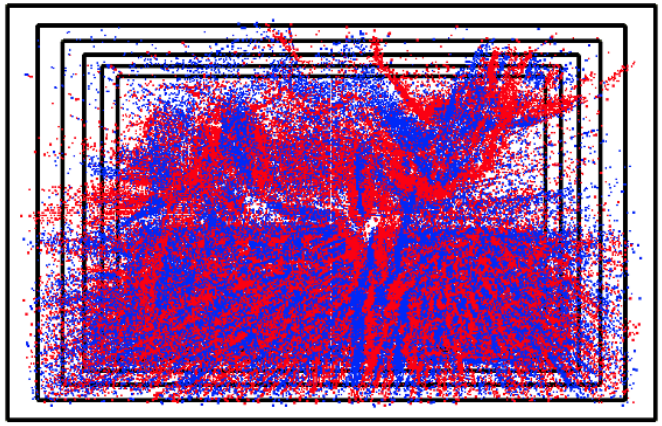

- Small parameter space
- Spiking

Convolutional Neural Network

Laplacian's Prediction

ANN to SNN

Spiking CNN

Laplacian's Prediction

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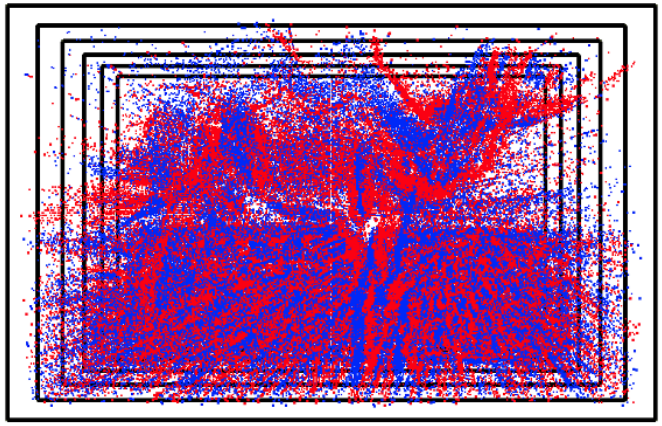

- Small parameter space
- Spiking

Convolutional Neural Network

Laplacian's Prediction

ANN to SNN

Spiking CNN

Laplacian's Prediction

SNN

Poisson Integration

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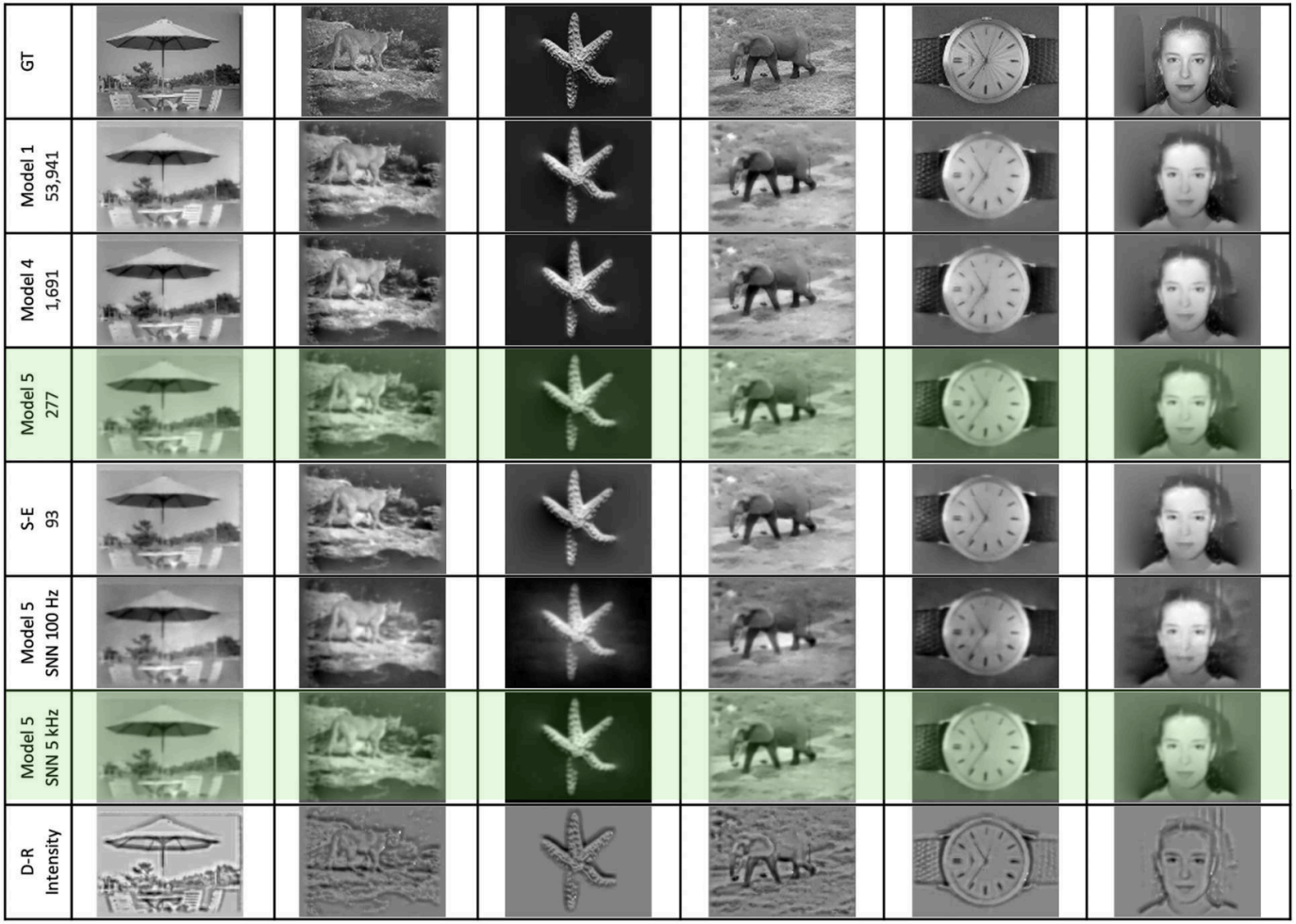
Results



	#	filters	params	PSNR	SSIM	MSE
$\hat{L}$+PI	1	50,100,50,20,1	53,941	24.29	0.864	0.0042
	2	50,50,50,20,1	28,891	24.31	0.859	0.0042
	3	20,20,20,20,1	5,581	24.47	0.858	0.0042
	4	10,10,10,10,1	1,691	24.67	0.861	0.0039
	5	3,3,3,3,1	277	24.23	0.844	0.0042
	6	3,1,3,1,1	205	23.86	0.838	0.0047
	S_M	3*,2*,3,3,1	93	23.04	0.824	0.0058
	S_R	3*,2*,3,3,1	93	11.40	0.326	0.0734
	$SNN^{\cdot 1}$	3,3,3,3,1	277	17.90	0.679	0.0217
	SNN^{5}	3,3,3,3,1	277	19.36	0.756	0.0147
$\hat{I}$	1	50,100,50,20,1	53,941	19.53	0.519	0.0117
	4	10,10,10,10,1	1,691	19.60	0.512	0.0114
	5	3,3,3,3,1	277	19.22	0.490	0.0124

Evaluated on:

- **N-MNIST**
- **N-Caltech101**

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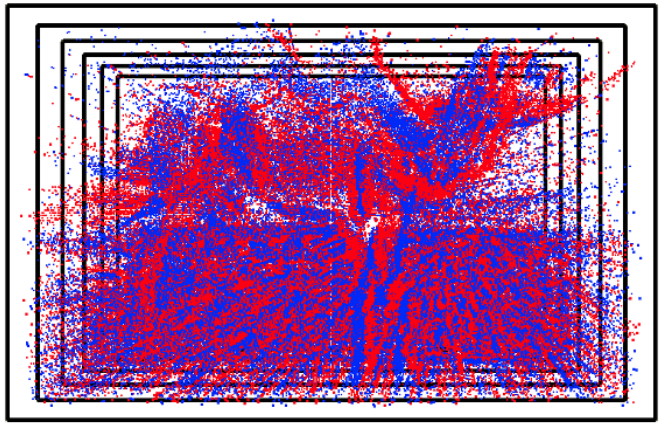
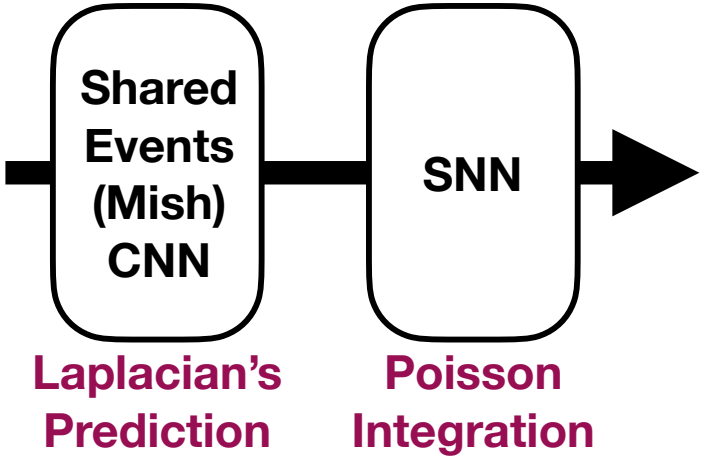
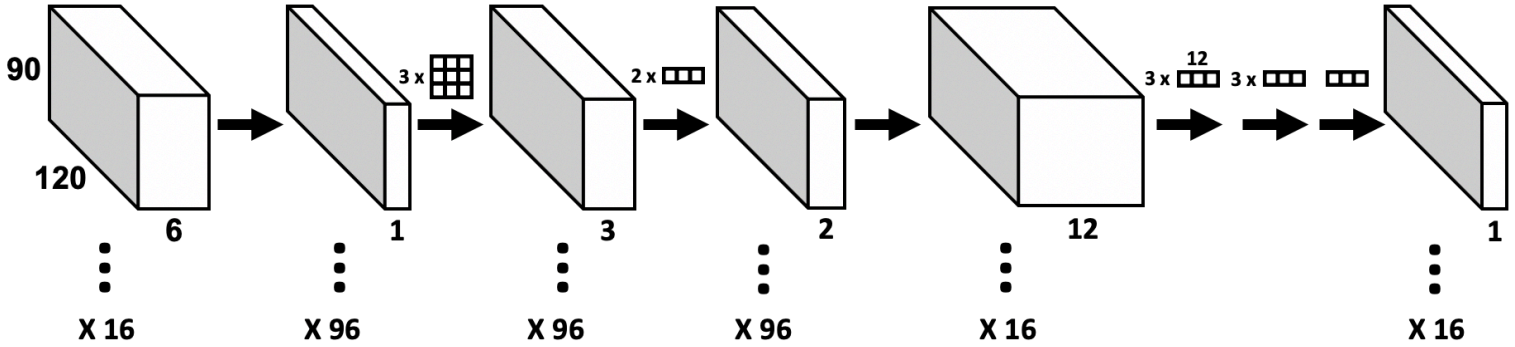
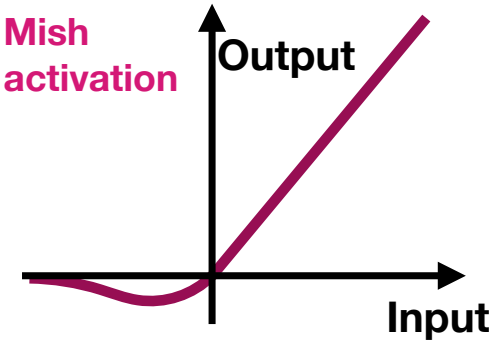




- Miniscule parameter space





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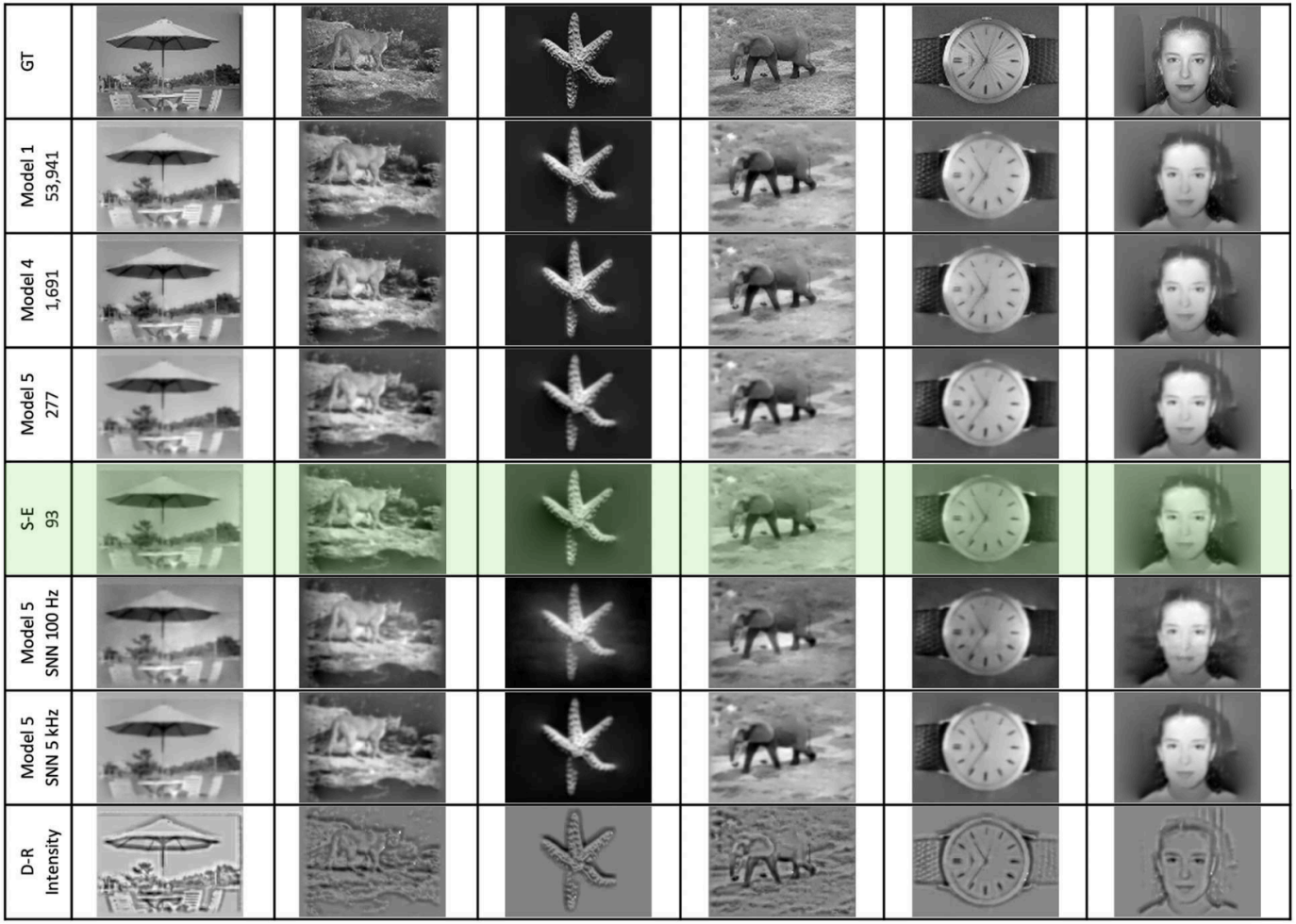

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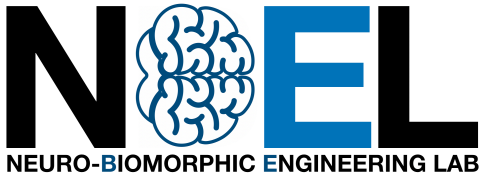

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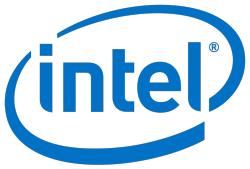

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