Differentiable Event Stream Simulator for Non-Rigid 3D Tracking

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CVPR 2021 Workshop on Event-based Vision

Graphics Vision & Video

mpii max planck institut informatik

SIC Saarland Informatics Campus

Google

Introduction: Problem Statement

"Track non-rigid objects in 3D using an event camera"

DAVIS 240C*

*https://inivation.github.io/inivation-docs/Hardware%20user%20guides/User_guide_-_DVS128.html

Motivation

- Micro-second resolution (**High frame rate**).

- No redundancy, low latency.

- High Dynamic Range (120dB).

- Low power usage (mW).

Advantages of using Event Cameras

- Motion blur during tracking using conventional cameras.

- High Redundancy using high frame rate cameras.

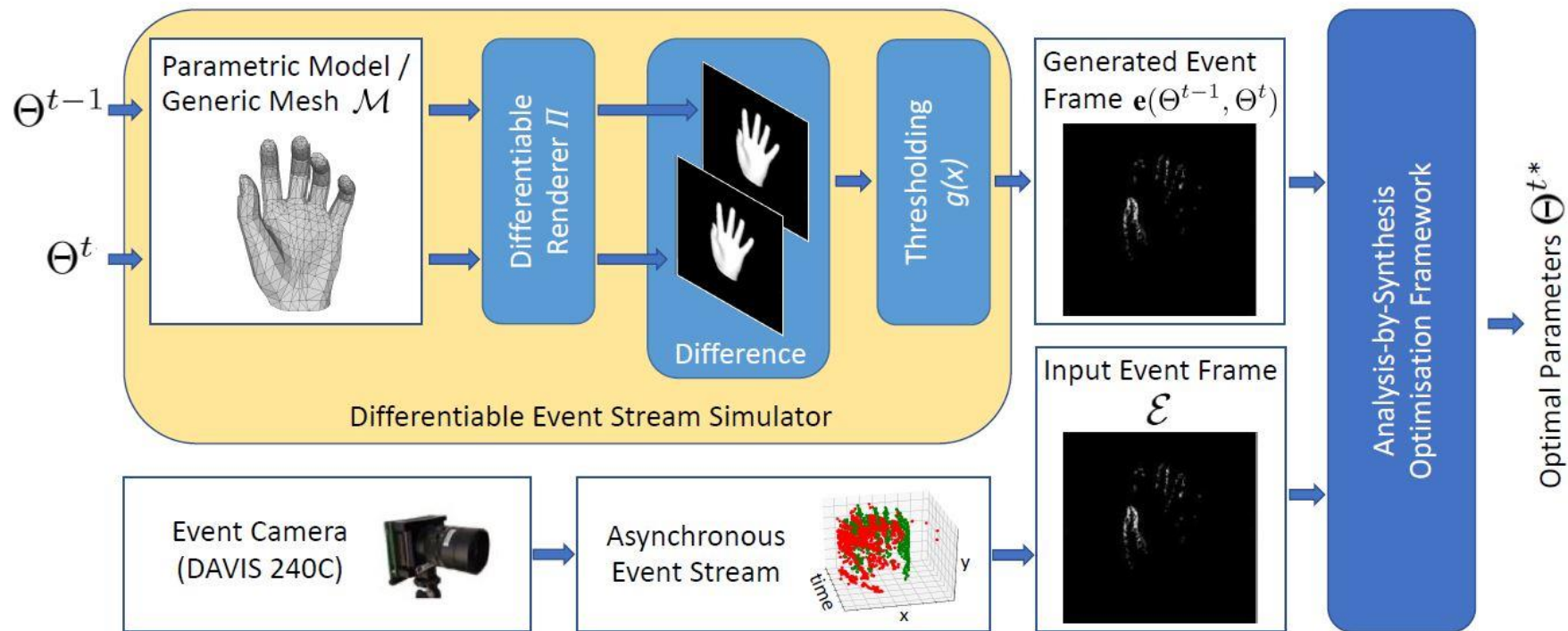# Introduction: Event Camera

- **Event Generation Model:**

  At time stamp t_k

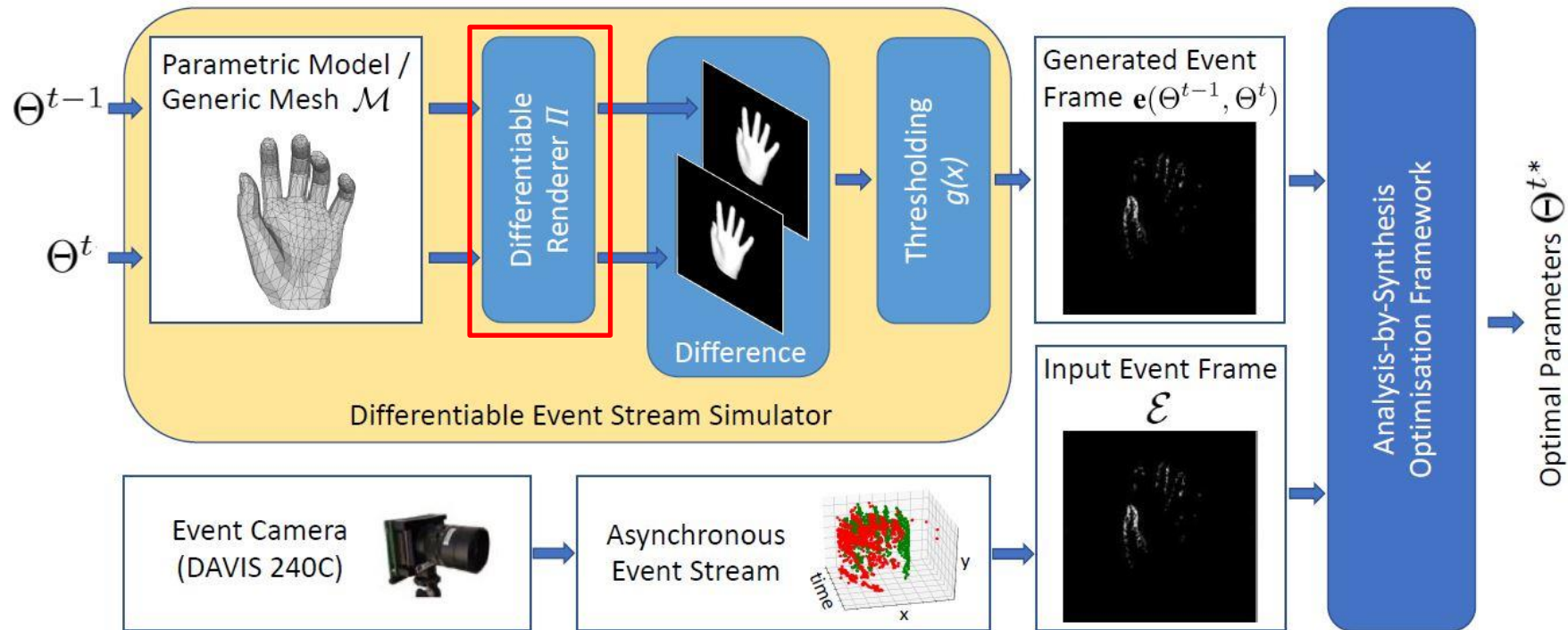 $$\boxed{\left| \mathcal{L}(x_k, t_k) - \mathcal{L}(x_k, t_k - \Delta t_k) \right| \geq C}$$ at each pixel x
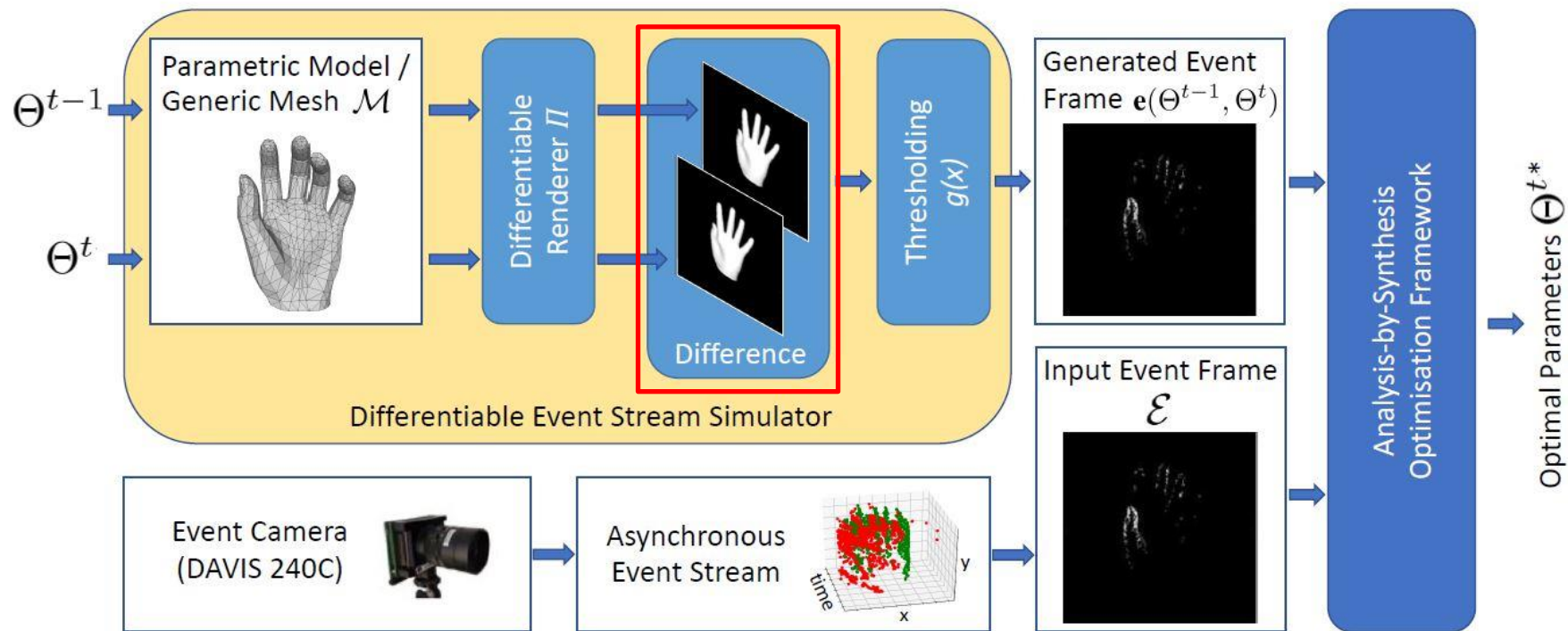
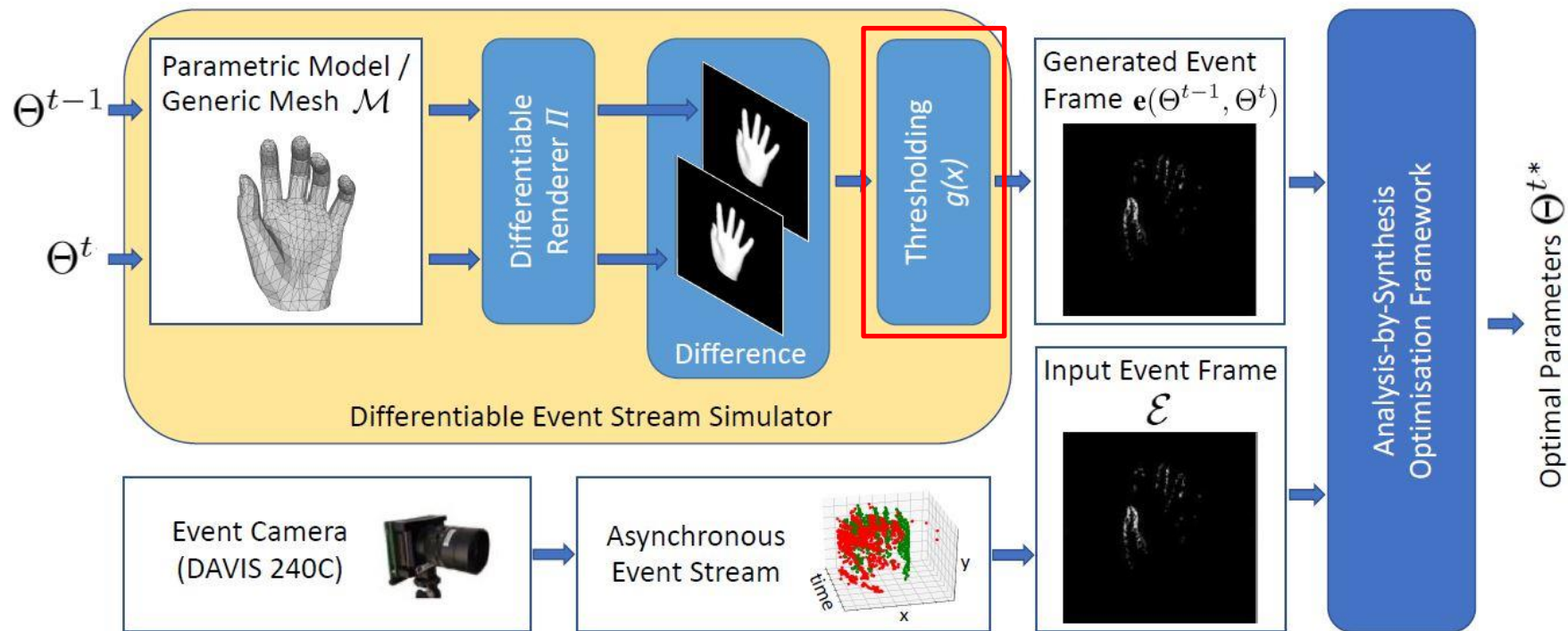 $\mathcal{L}$: brightness C: threshold parameter

Method: Pipeline

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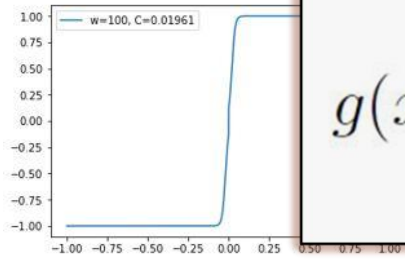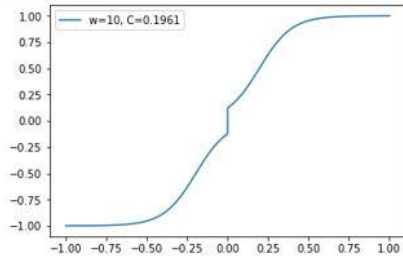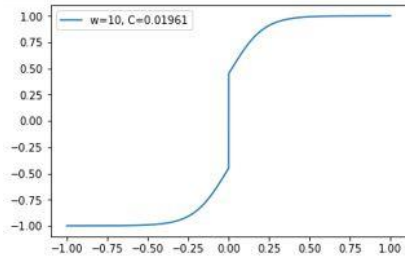
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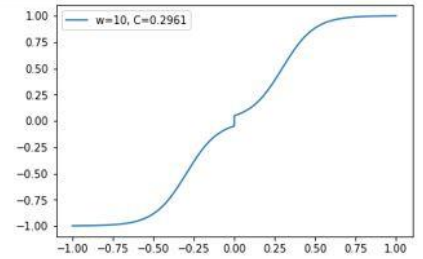
$$g(x) = \left(\frac{x + \epsilon}{|x| + \epsilon} \right) \left(\frac{1}{1 + e^{-w|x| + wC}} \right)$$
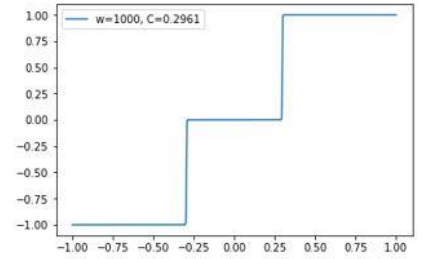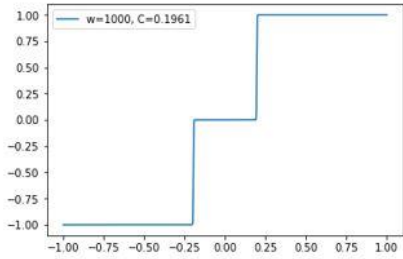
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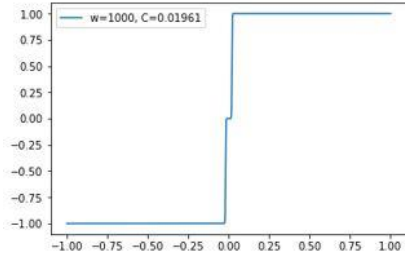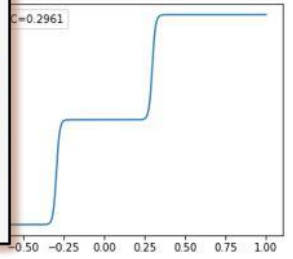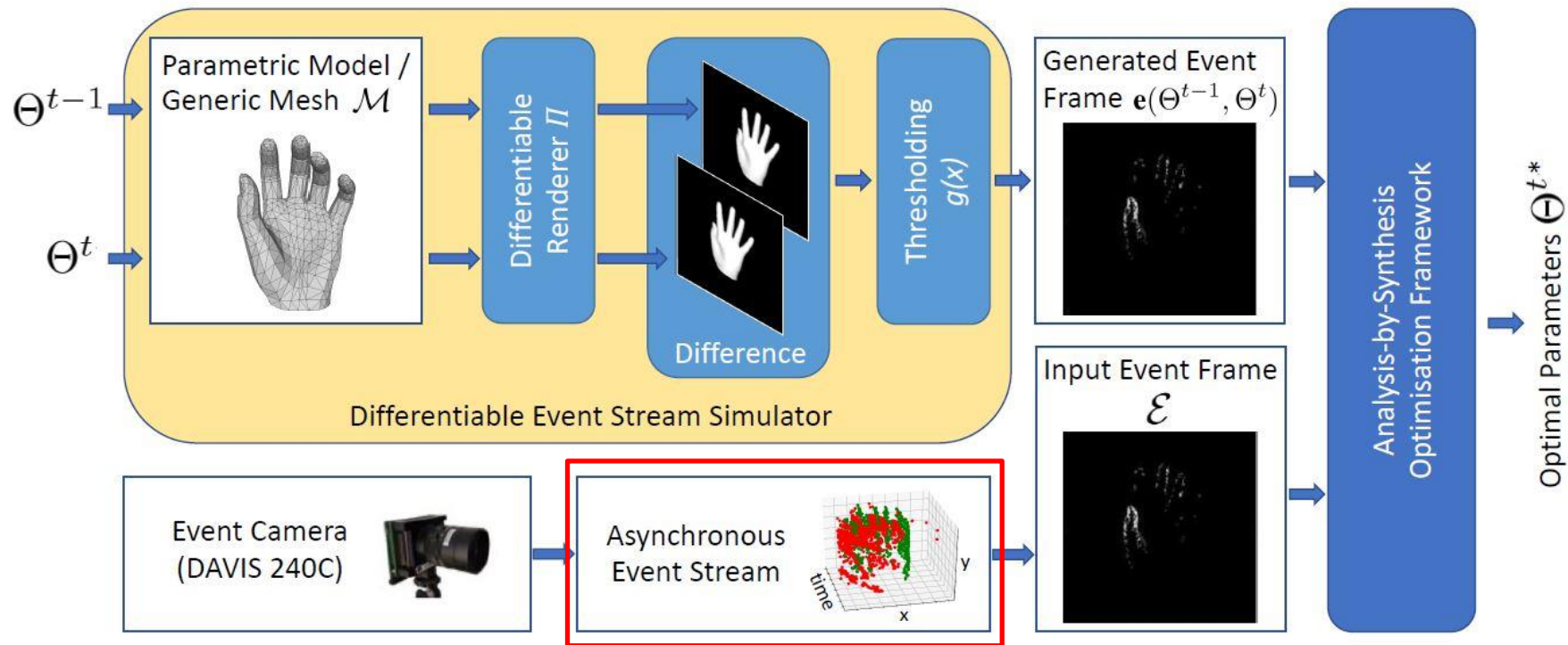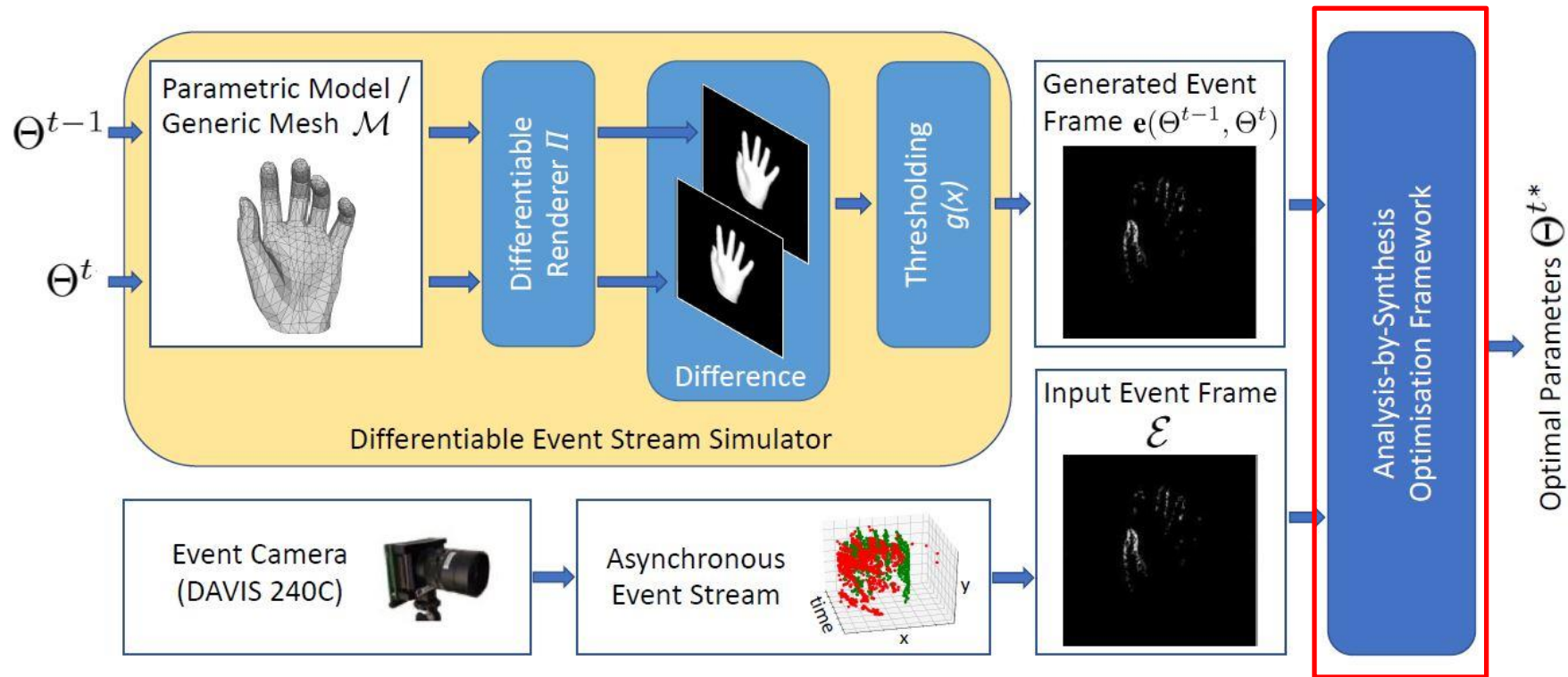# Results: Synthetic Data
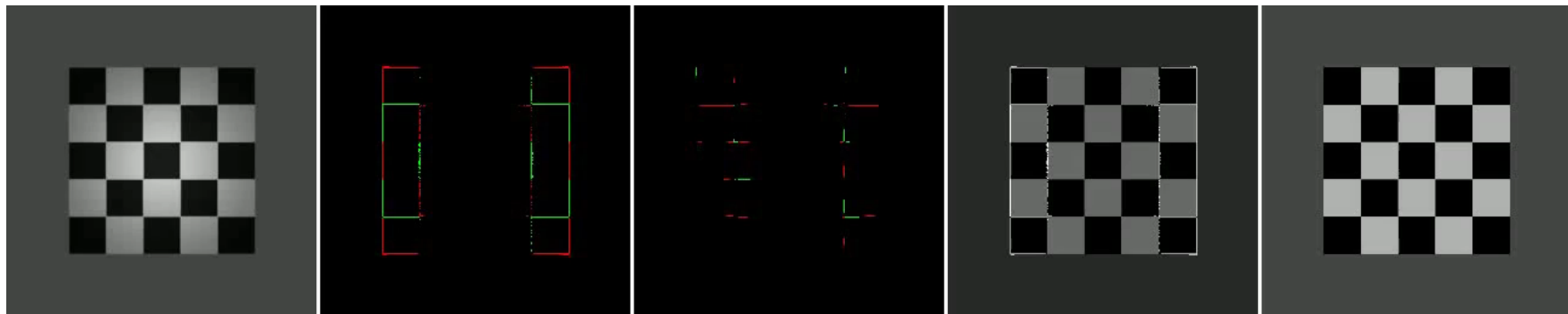

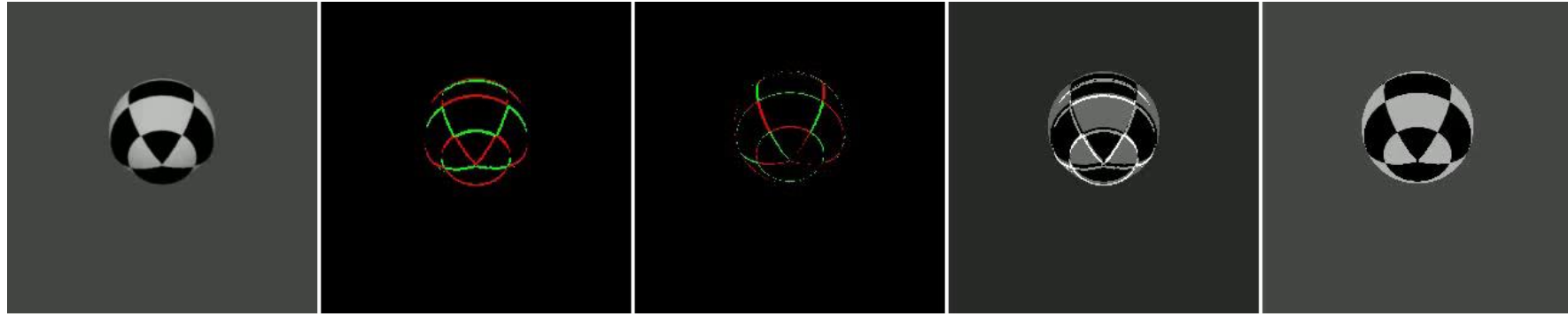| Input Image | Input events | Generated events | Overlaid result | Result |

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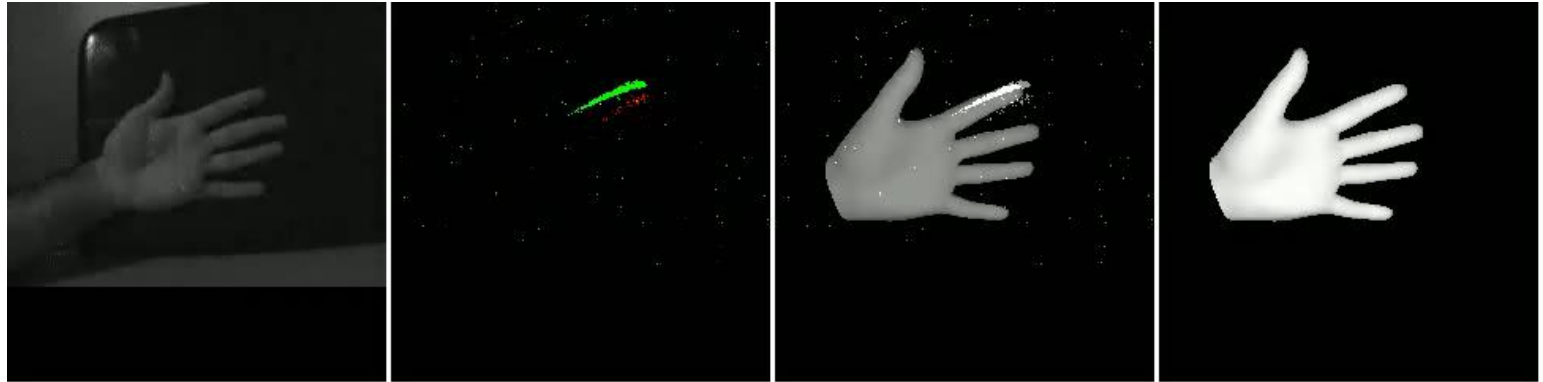| Input Image | Input events | Generated events | Overlaid result | Result |

Results: Quantitative Comparisons

Sequence	Method	3D error	Std. deviation
Synthetic Hands	HandGraphCNN	0.191	0.055
	Ours	0.074	0.027
Synthetic Paper	DDD	0.266	0.12
	Tien Ngo *et al.*	0.235	0.158
	IsMo-GAN	0.384	0.092
	Ours	0.232	0.135
Synthetic Ball	DDD	0.656	0.151
	Ours	0.47	0.31

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Results: Real Data
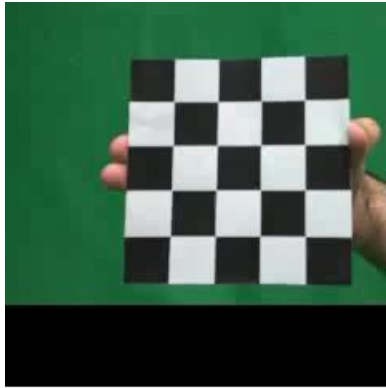

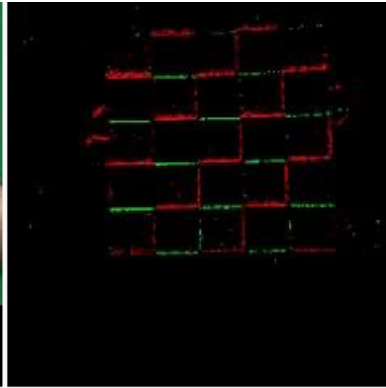Input Image   Input events   Overlaid result   Result
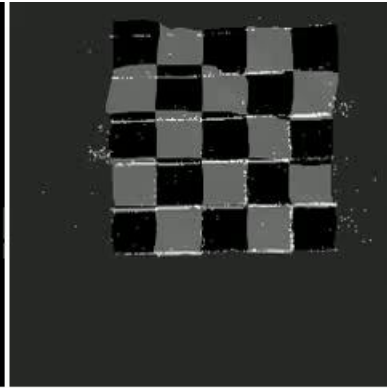
Results: Real Data

Input RGB   Input events   Overlaid result   Result

Thank You!

Check out our project page for the paper and source code:
http://gvv.mpi-inf.mpg.de/projects/Event-based_Non-rigid_3D_Tracking/