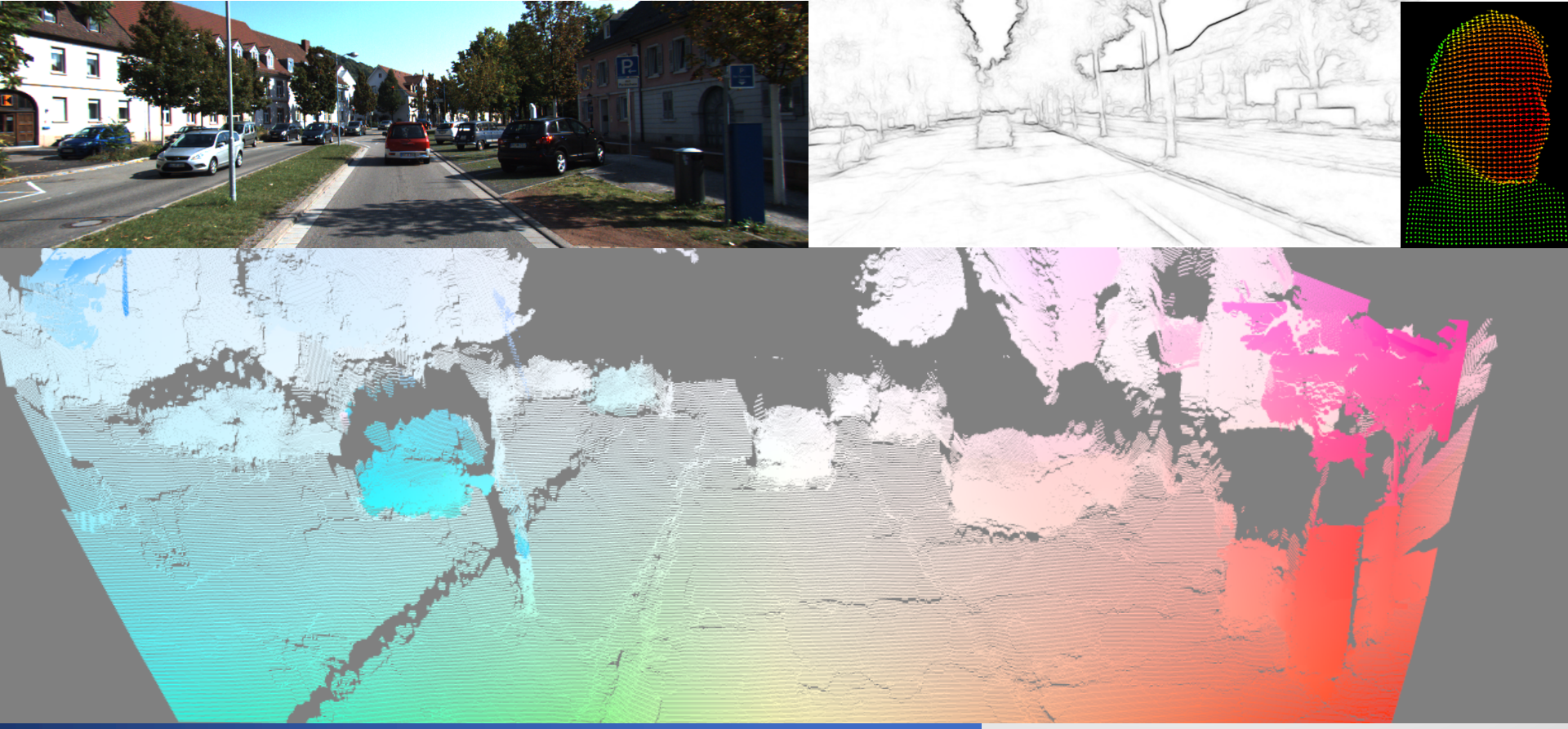


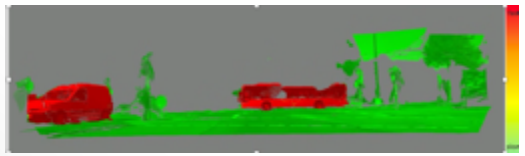
Augmented Vision - Umwelterfassung und Selbstlokalisierung

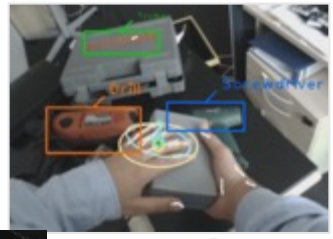
Didier Stricker

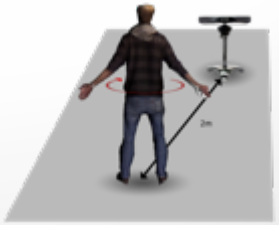
Didier.Stricker@dfki.de

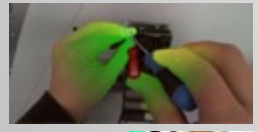
Forschungsbereich Augmented Vision @ DFKI Kaiserslautern

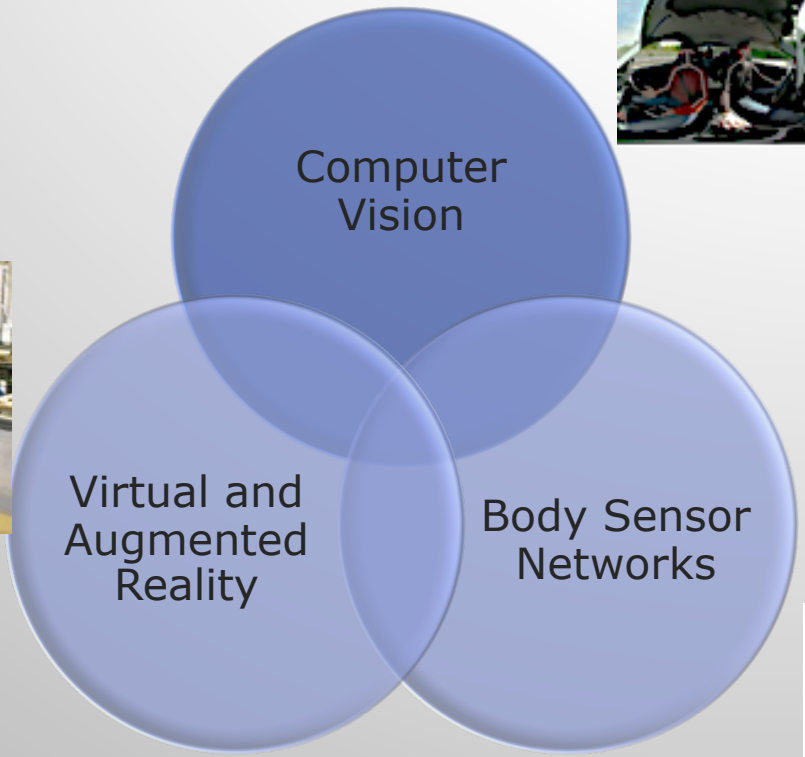
- Leitung: Prof. Didier Stricker
- 50 Doktoranden und wiss. Mitarbeiter
- Drei zusammenhängende Fachgebiete

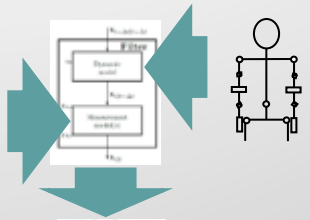


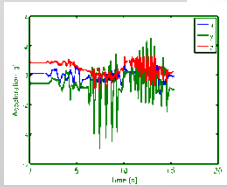


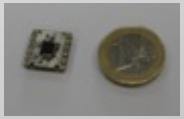






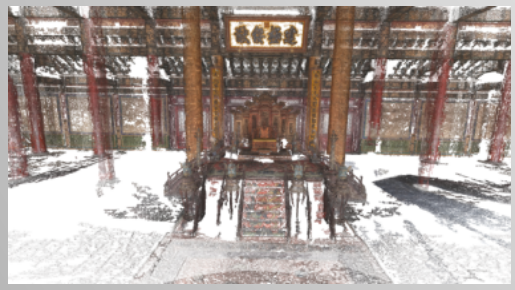


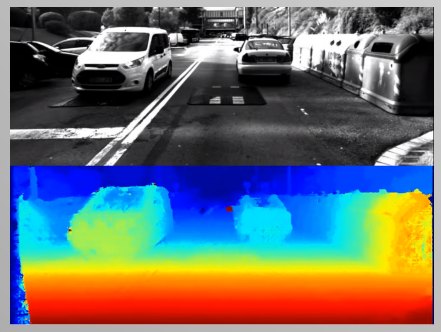


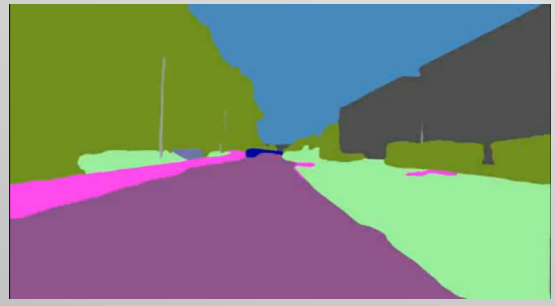


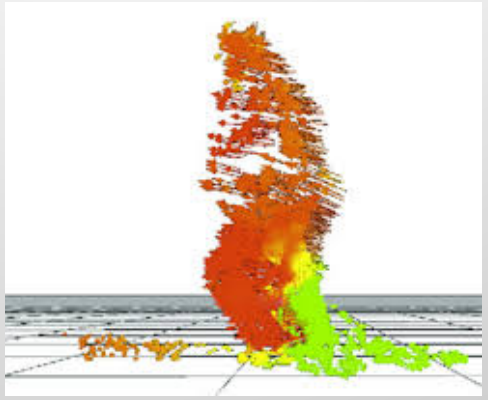
Visuelle Wahrnehmung

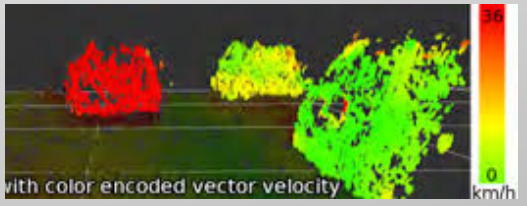
Geometry	Semantic	Dynamics
• Multiple view geometry	• Object recognition	• **Dense 4D reconstruction**
• Real-time stereo	• Semantic Segmentation	• **Temporal integration** (in order to understand events!)







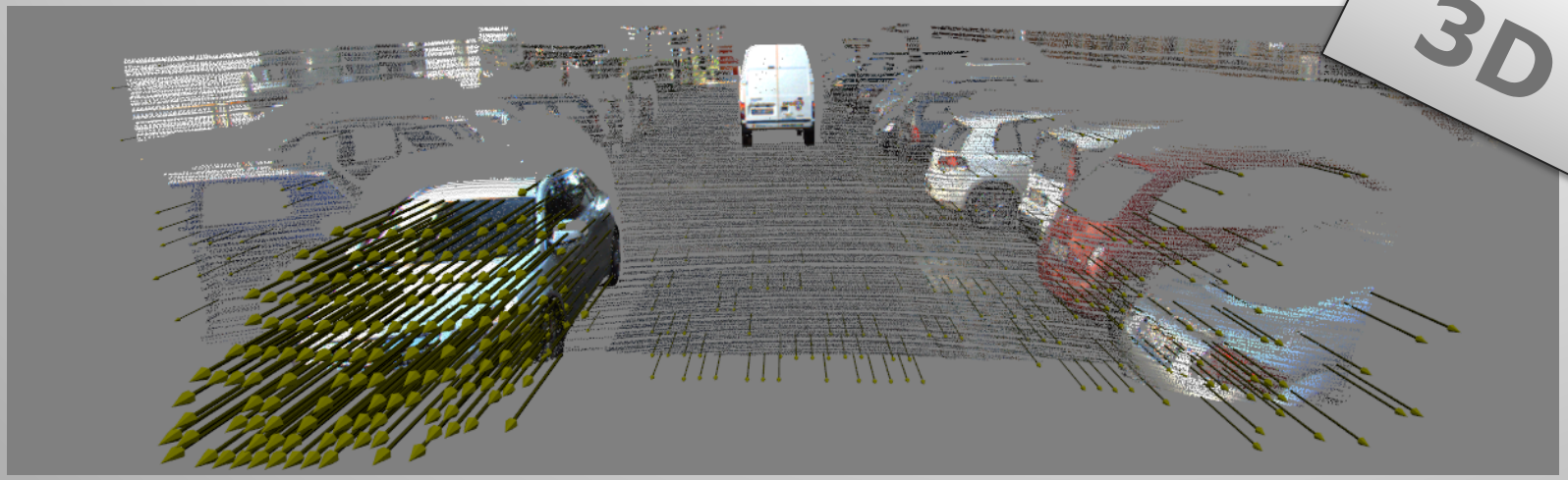




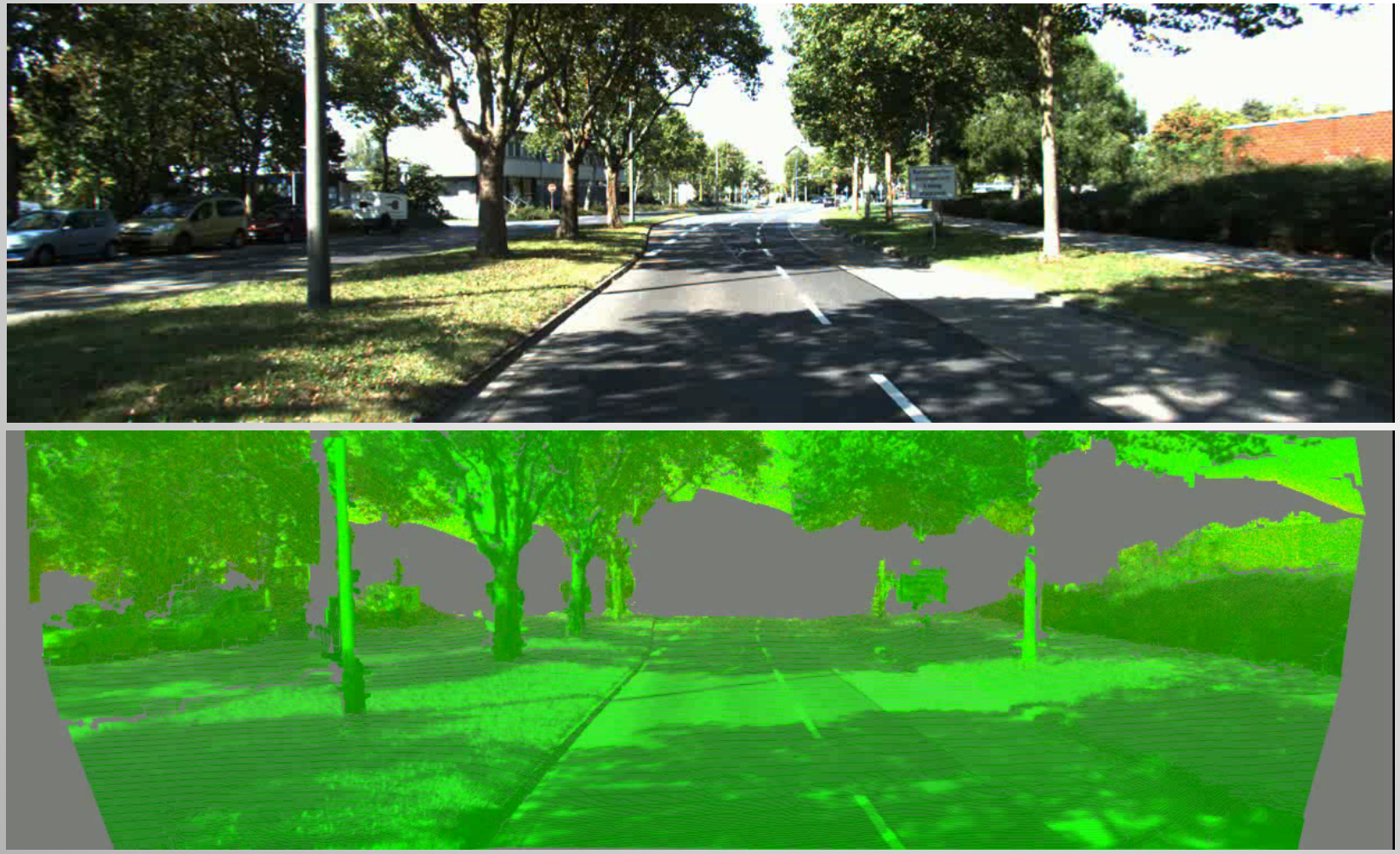
Optical Flow vs. Scene Flow

Optical Flow

Scene Flow



3D Erfassung der Geomertie und Dynamik



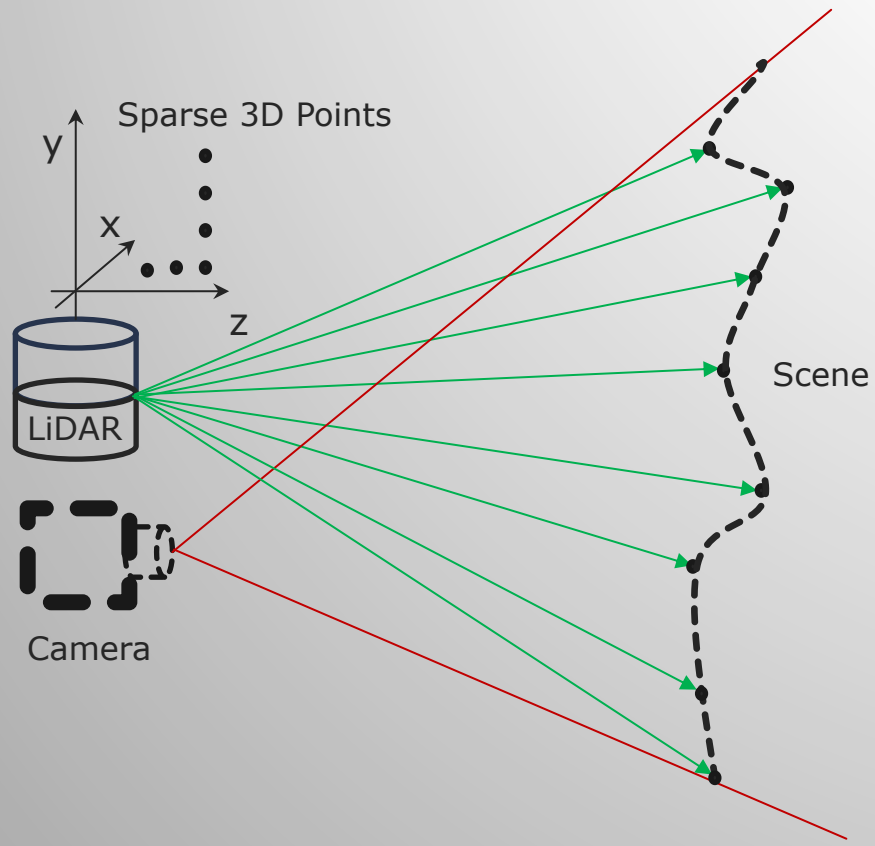
René Schuster, Oliver Wasenmüller, Georg Kuschk, Christian Bailer and Didier Stricker. „Towards Flow Estimation in Automotive Scenarios“, ACM Chapters Computer Science in Cars Symposium (CSCS), 2017.

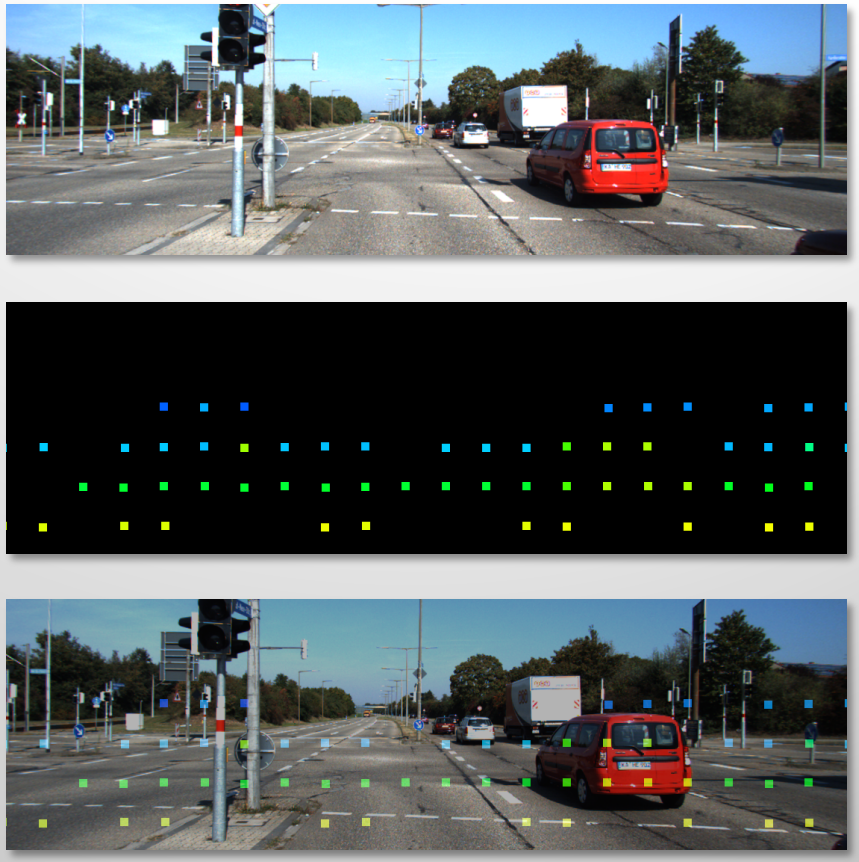
René Schuster, Christian Bailer, Oliver Wasenmüller and Didier Stricker. “Combining Stereo Disparity and Optical Flow for Basic Scene Flow”. Commercial Vehicle Technology Symposium (CVTS), Springer, 2018.

René Schuster, Oliver Wasenmüller, Georg Kuschk, Christian Bailer and Didier Stricker. „SceneFlowField: Dense Interpolation of sparse scene flow correspondences“, IEEE Winter Conference on Computer Vision (WACV), 2018.

Fusion: Kamera-LiDAR

Sparse MEMS-LiDAR

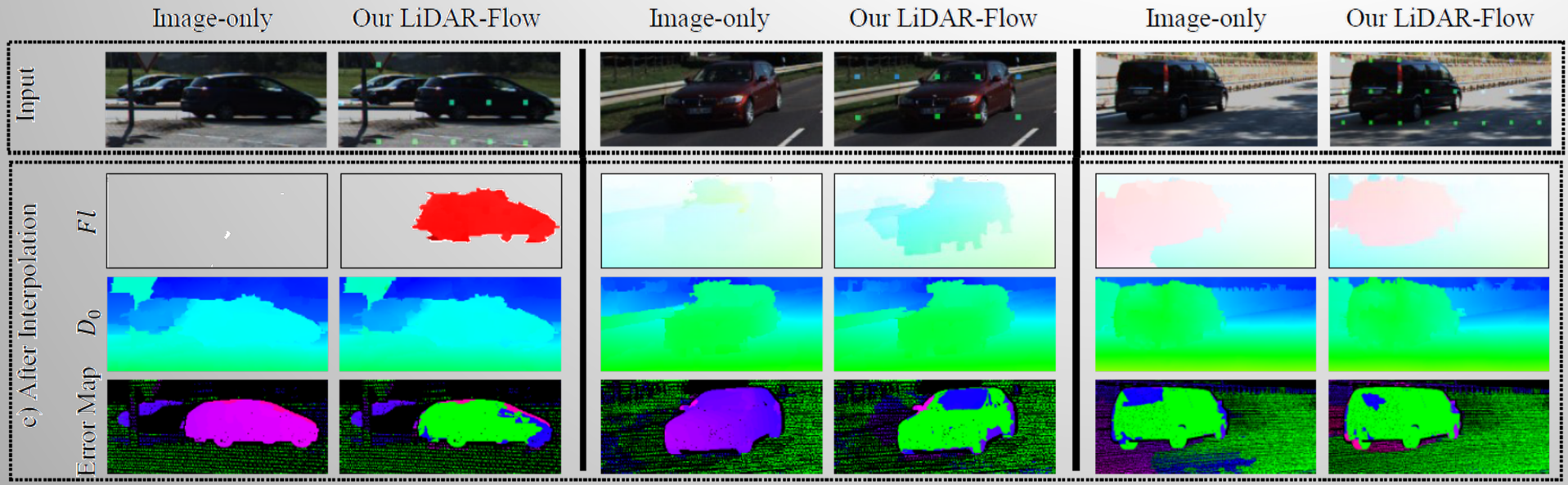




Ramy Battrawy, René Schuster, Oliver Wasenmüller, Qing Rao, and Didier Stricker, "LiDAR-Flow: Dense Scene Flow Estimation from Sparse LiDAR and Stereo Images," in IEEE International Conference on Intelligent Robots and Systems (IROS), 2019

Fusion: Kamera-LiDAR

	SF Outliers [%]		
	Seeds	Window	Dense
SFF++ [4]	16.05	13.89	14.51
LiDAR-Flow	**7.88**	**8.70**	**11.52**
Average no. of evaluated points	88	6820	91875



Ramy Battrawy, René Schuster, Oliver Wasenmüller, Qing Rao, and Didier Stricker, "LiDAR-Flow: Dense Scene Flow Estimation from Sparse LiDAR and Stereo Images," in IEEE International Conference on Intelligent Robots and Systems (IROS), 2019

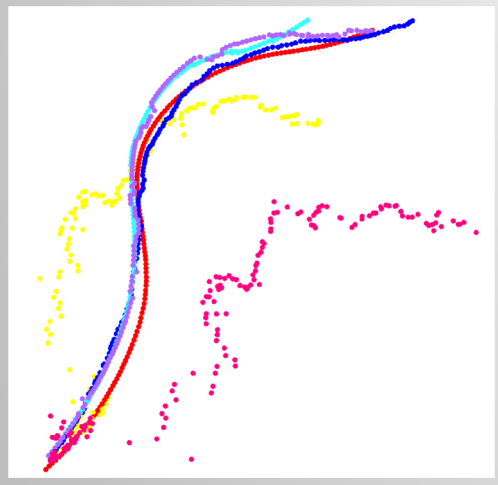
Problem: 3D Fußgänger Detektion

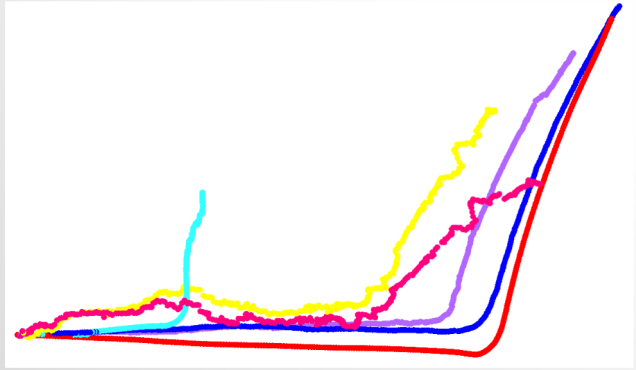
Ergebnis: Regen

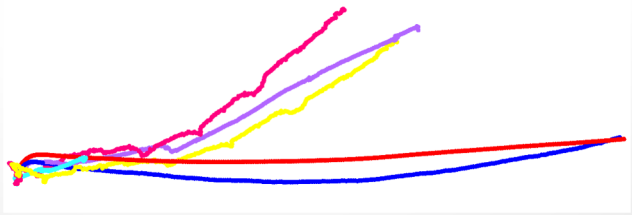
Ergebnis: Nachts

Odometrie: Lokalisierung mit LIDAR (ausführliche Evaluierung, KITTI Daten)

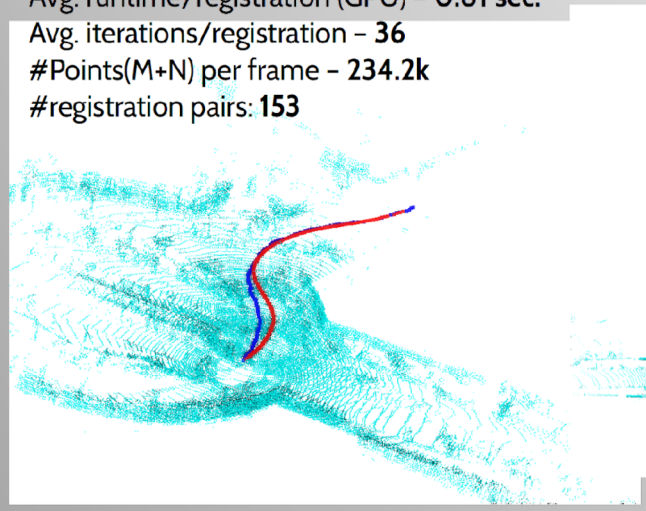
Ground Truth Path — FGA (ours) — ICP — GMMReg — FilterReg — CPD





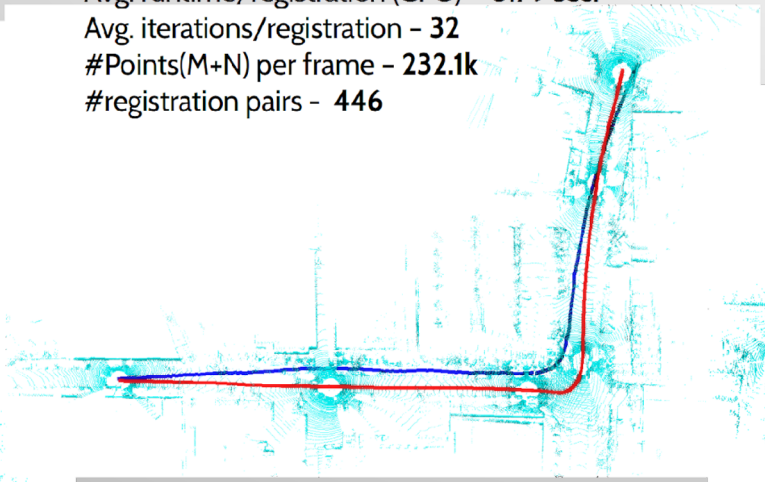


Avg. runtime/registration (CPU) – **75.8 sec.**
Avg. runtime/registration (GPU) – **0.81 sec.**
Avg. iterations/registration – **36**
#Points(M+N) per frame – **234.2k**
#registration pairs: **153**



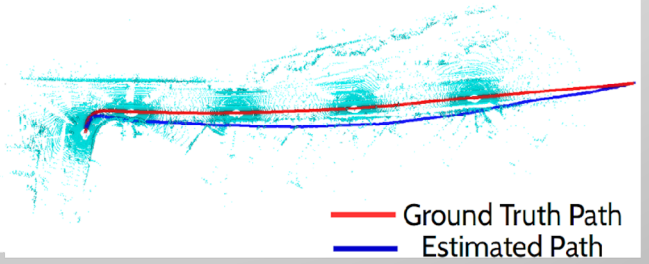
(a). 2011_09_26_drive_0005 Sequence

Avg. runtime/registration (CPU) – **70.3 sec**
Avg. runtime/registration (GPU) – **0.79 sec.**
Avg. iterations/registration – **32**
#Points(M+N) per frame – **232.1k**
#registration pairs - **446**



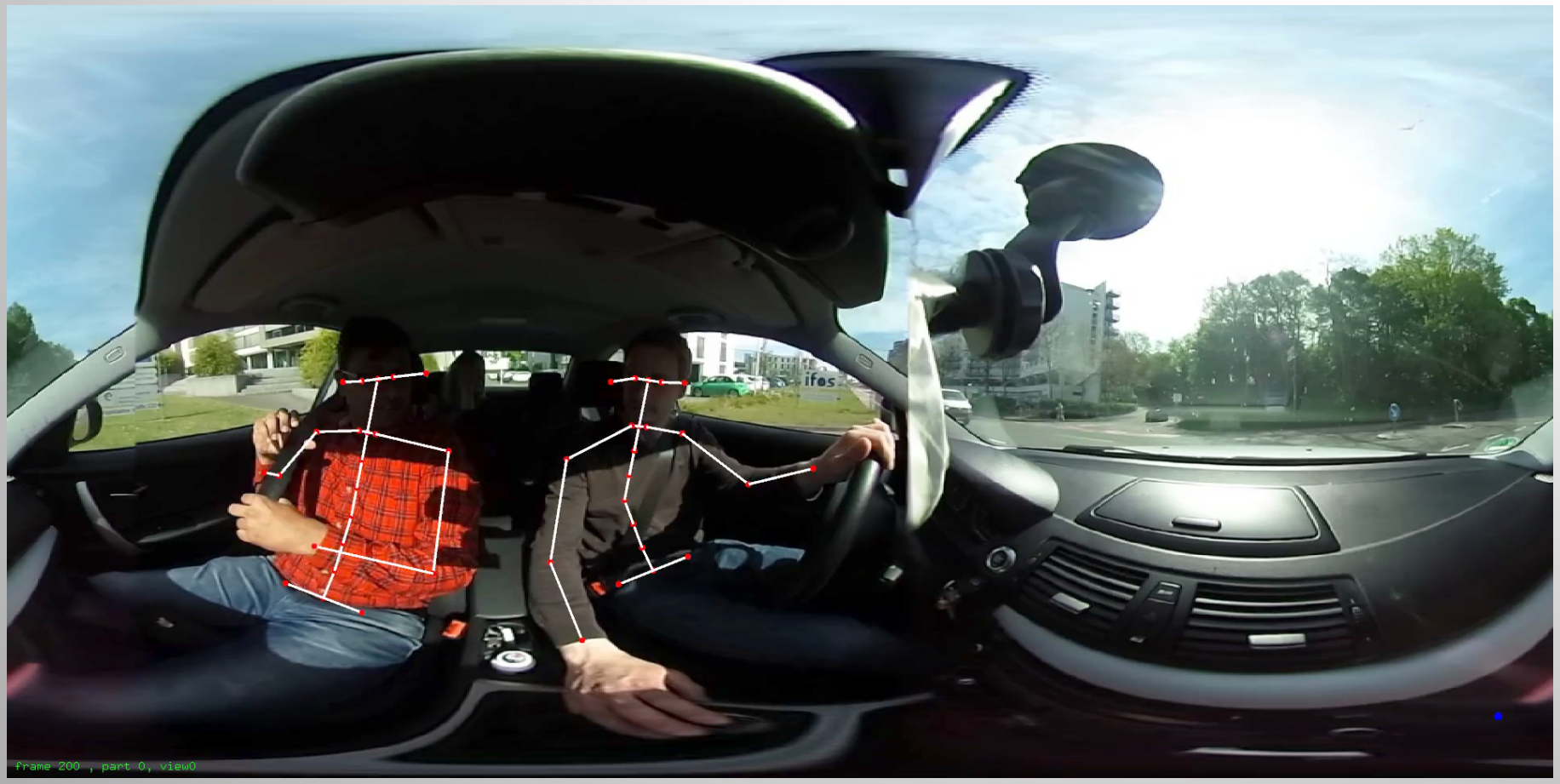
(b). 2011_09_26_drive_0009 Sequence

Avg. runtime/registration (CPU) – **67.28 sec**
Avg. runtime/registration (GPU) – **0.65 sec.**
Avg. iterations/registration – **34**
#Points(M+N) per frame: **224.4k**
#registration pairs: **313**

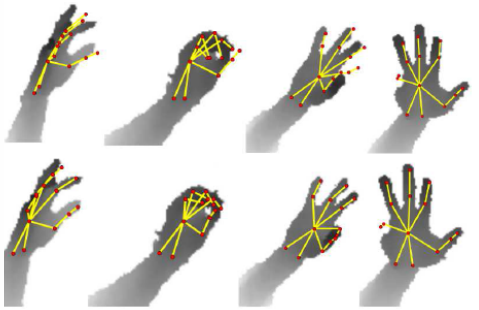


(c). 2011_09_26_drive_0014 Sequence

Human Pose Estimation



Eingebettete KI: FPGA



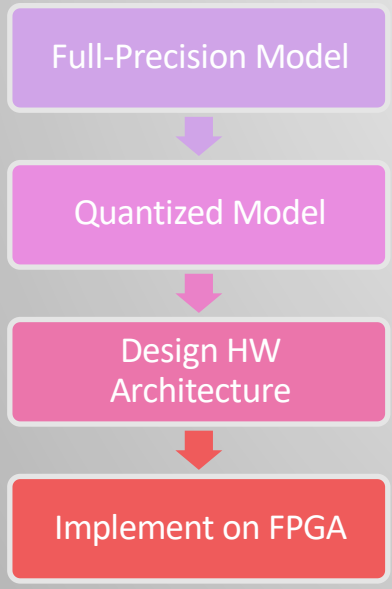
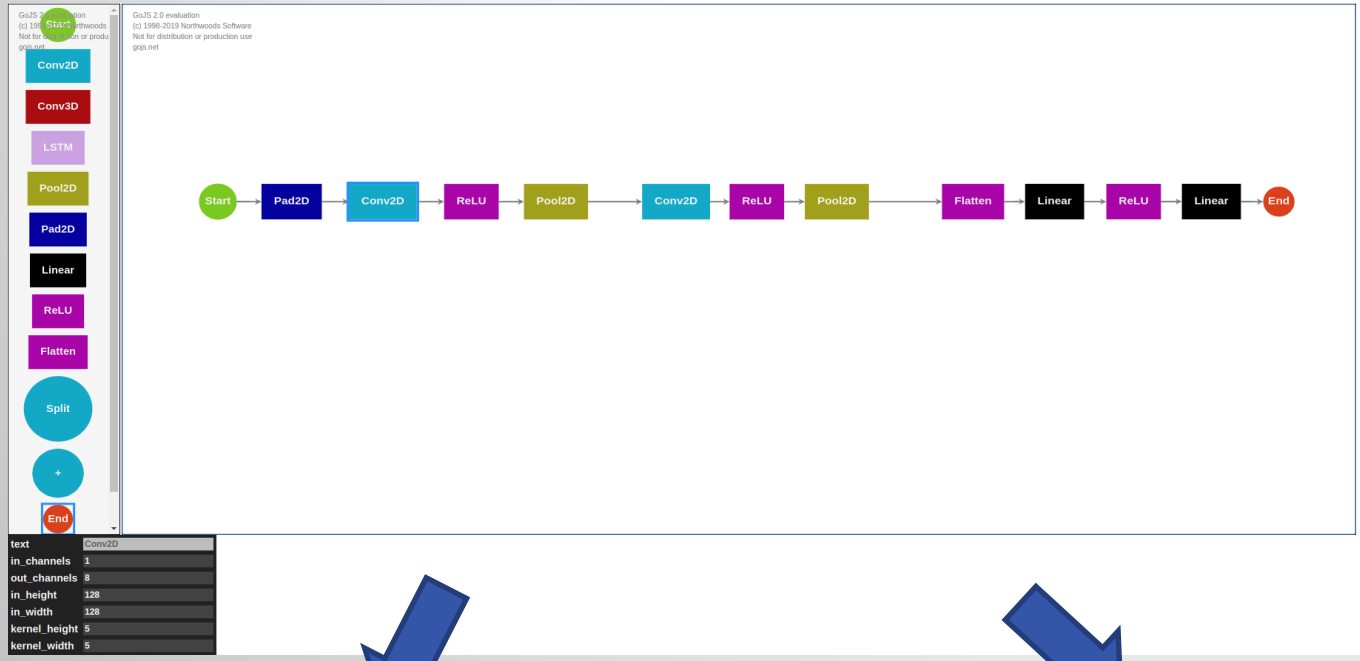


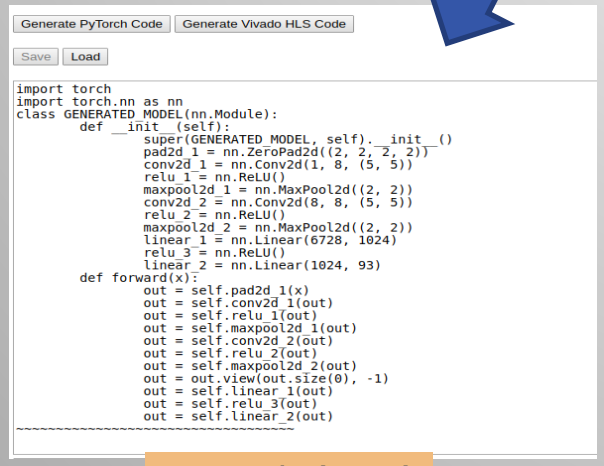
	Image Time [ms]	Effective Power [W]	Energy per Image [mJ]
FPGA	1.669	0.4	0.6676
GPU	7.01	54.98	385.41

- **4.2 Mal schneller**
- **Faktor 577 bei Energieeffizienz!**
- **Genauigkeit = ca. -2%**

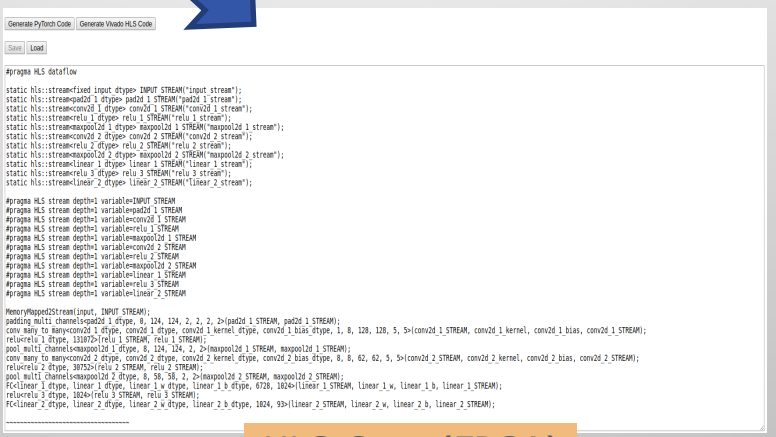
GPU: GeForce GTX 1070
FPGA Kit: ZYNQ UltraScale+ MPSoC ZCU102 (FPGA: XCZU9EG)

DeepGUI : DragnDrop Deep Learning





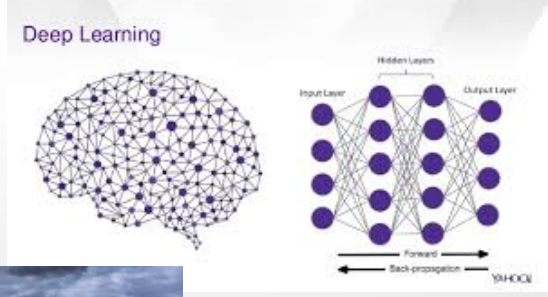
PyTorch (GPU)



HLS C++ (FPGA)

Ausblick

- Fusion von **Modalitäten** und **Methoden**
- Eingebettete Lösung oder **„Edge AI"** wird eine zentrale Rolle spielen
- **„Continual Learning" - Lernen mit wenigen Beispielen und mit reduzierter Hardware**
- Von PKW zu Arbeitsmaschinen: **Autonomes Fahren und autonomes Arbeiten (Rauhe Umgebungen)**



Thank you for your attention!

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