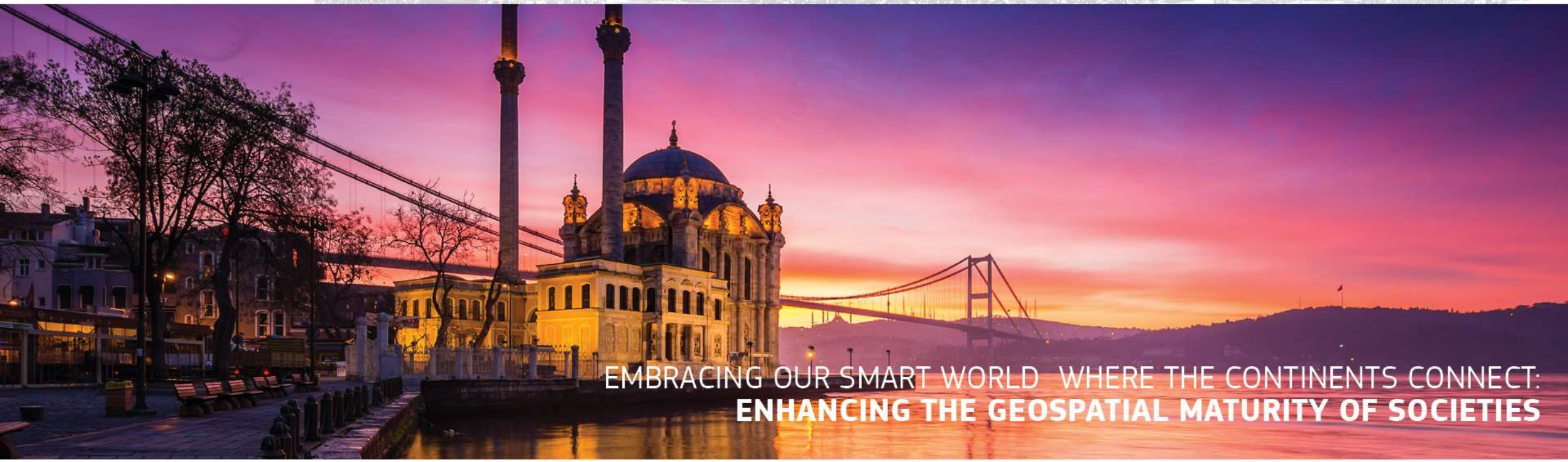
FIG 2018 ISTANBUL

XXVI FIG CONGRESS

6–11 May 2018, İstanbul



EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:
ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES

Organized by

FIG INTERNATIONAL FEDERATION OF SURVEYORS

Main Supporters

T.C. ÇEVRE VE ŞEHİRCİLİK BAKANLIĞI

Tapu ve Kadastro

Platinum Sponsors

Trimble. Leica Geosystems esri

Quantitative Evaluation of structure from motion software for the 3D-reconstruction of traffic accidents

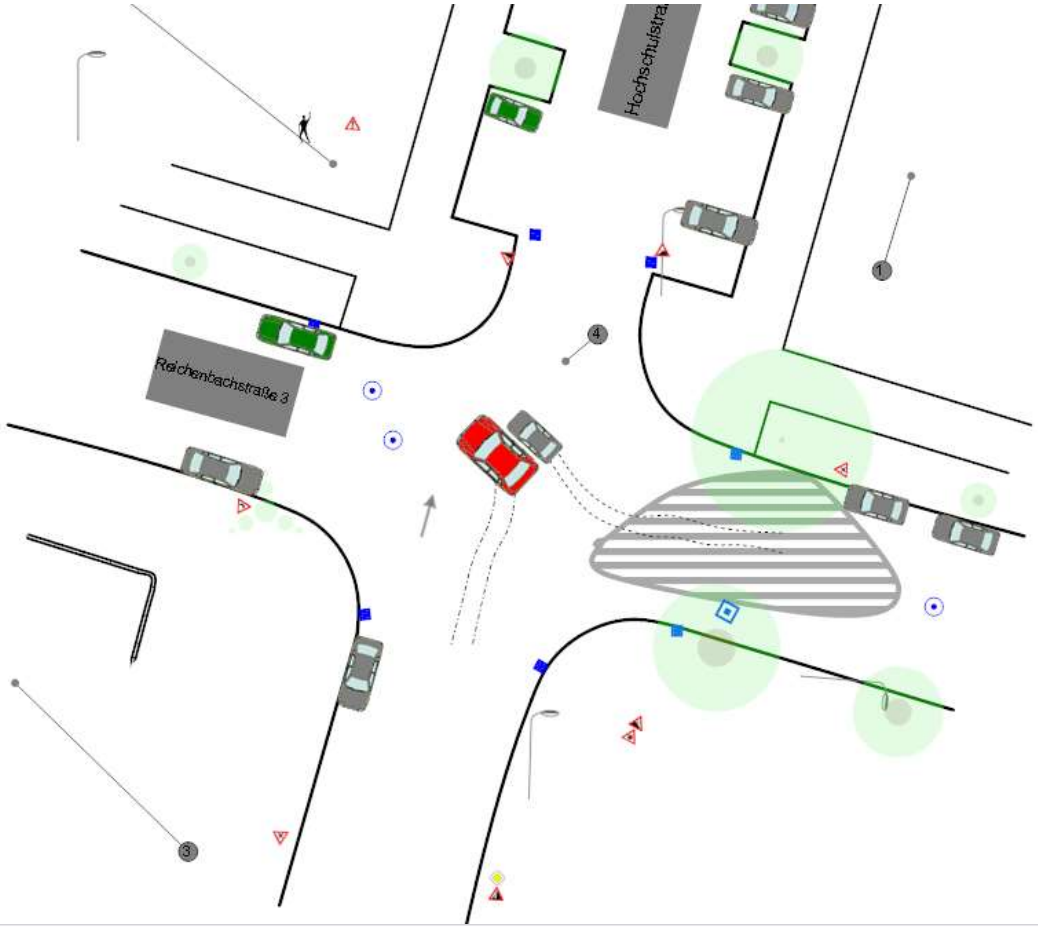
Tim Kaiser, Christian Clemen, Robert Kaden

European Union
European Regional Development Fund
European Social Fund

Europe funds Saxony.
EFRE ESF

Introduction

- In case of severe traffic accidents, German police is required to provide a sketch of the incident location



Mapping of traffic accidents

- Mandatory accuracy ⟷ Time for acquisition

- Typical Measuring Methods:
  - Surveyor's wheel
  - Total station
  - Laser Scanner
  - Photogrammetry

[1]

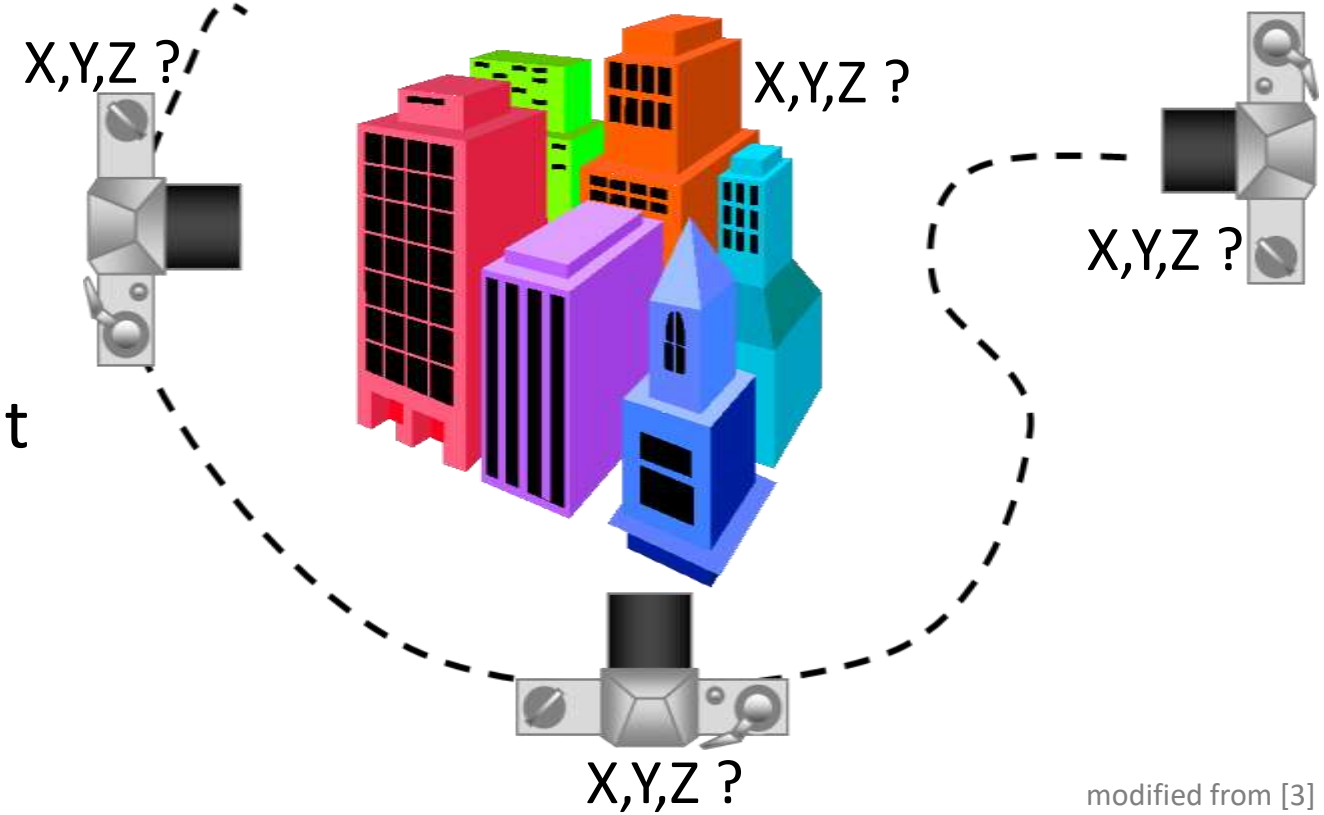
[2]

- Expensive Equipment and extensive training required
- Possible Alternatives? -> Structure from Motion

Structure from Motion (SfM)

Reconstruction of

- Camera Locations + Camera Parameters = Interior + Exterior Orientation
- Object coordinates as 3D-Point Cloud
- → Low-Cost 3D-Reconstruction method



modified from [3]

Investigated Software Packages

- 4 open-source and 1 commercial SfM tools were investigated
  - Colmap
  - openMVG
  - VisualSfM
  - regard3D
  - Agisoft Photoscan
- All test were performed using default parameters
- Aim: find best SfM-tool for data acquisition

Software Characteristics

	VisualSFM	openMVG	Colmap	regard3D	Agisoft Photoscan
Dense Matching	PMVS/CMVS	openMVS	integrated (CUDA required)	openMVS	integrated
License	Freeware (not for commercial purposes)	Mozilla Public License 2	GNU General Public License v3	MIT License	Proprietary
Camera Model parameters (in addition to fx, fy, cx, cy)	k1 (one set of parameters for each image)	various models; k1,k2,k3	various models; k1	various models; k1	k1, k2, k3, p1, p2 one model for all images
Feature Detector	SIFT	SIFT + AKAZE	SIFT	AKAZE	Proprietary
Hardware specialties	Video card required	-	CUDA card required	-	-

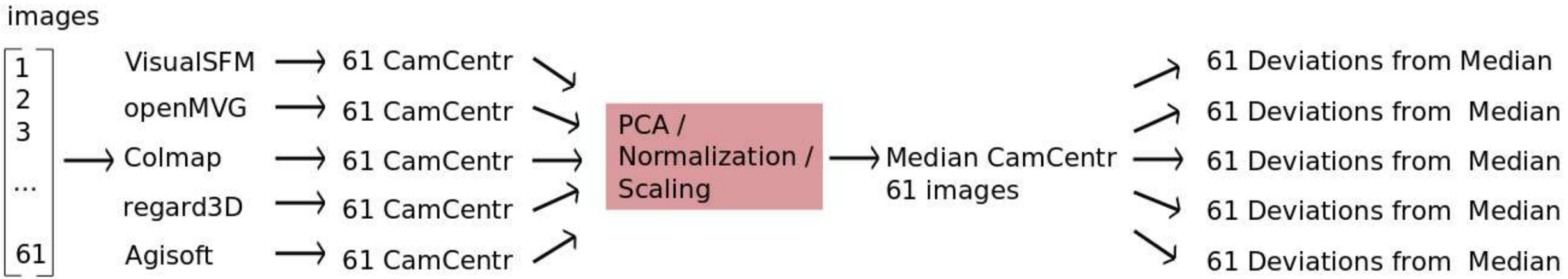
Sample Data

- 61 images of an intersection in densely build urban area
- Canon EOS 5D Mark III with 5670 x 3840 pixel
- No GCP were measured

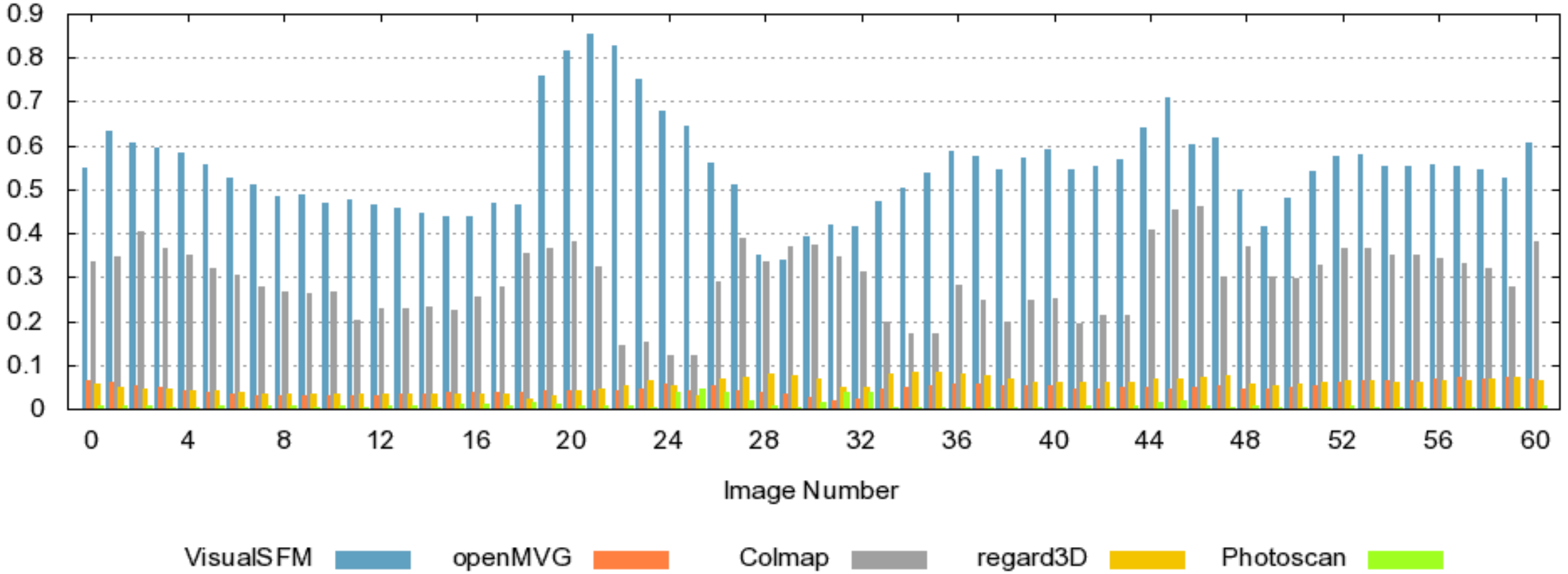
Overall Results

	VisualSFM	openMVG	Colmap	regard3D	Agisoft Photoscan
Registered Images	61	61	61	61	61
Processing Time [min.]	6.5	25	5	148	5.5
Nr. Points in Sparse Cloud	4456	32778	5879	27484	22471

Workflow for geometric investigation



Deviation [m] from median for every image



Discussion and Conclusion

- Agisoft Photoscan with best results
- VisualSFM (Colmap partly) shows high deviations
  - Downscaling of high resolution images -> less keypoints
- Results of openMVG and regard3D are acceptable

Discussion and Conclusion

- Feature detection algorithms have difficulties to find keypoints on roads

Summary

- Structure from Motion can be applied for traffic accident mapping
- Open source tools can deliver satisfying results
- Future research:
  - Point cloud segmentation
  - Georeferencing
  - “Tuning” parameters

Image Credits

- [1] image by Dr. Schorsch, distributed under CC BY-SA 3.0 (https://commons.wikimedia.org/wiki/File:3DLaserscanner_on_tripod.jpg)
- [2] image by Suricata, distributed under CC BY-SA 3.0 (https://commons.wikimedia.org/wiki/File:MessradSuricata.jpg)
- [3] Steve Seitz, Computer Vision: Structure from Motion (2003)