Accuracy Evaluation and Improvement of the Calibration of Stereo Vision Datasets

Kai Cordes • Hellward Broszio

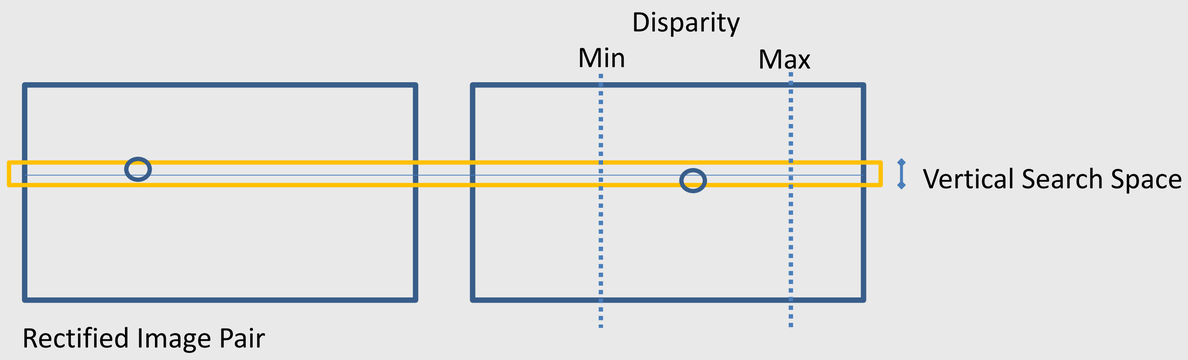
Stereo Vision Datasets

Stereo vision applications

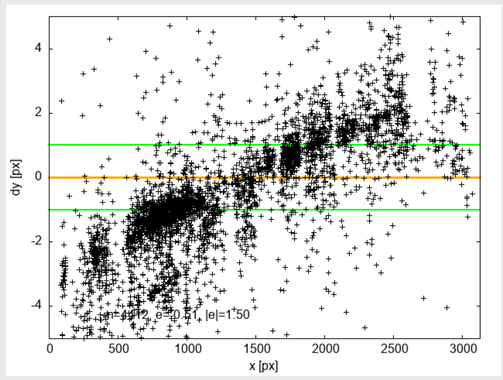
- Depth estimation
- Object detection
- Automated driving

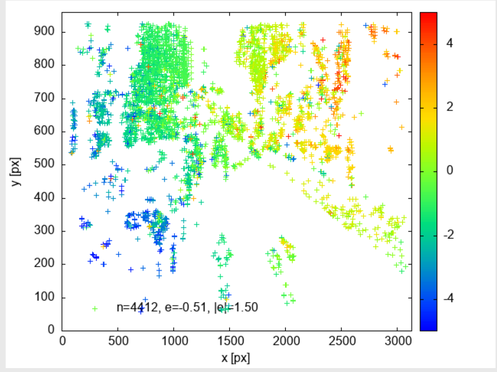
Datasets provide rectified images

- Corresponding image points have the same y-coordinate



ApolloScape Example





d_y: Vertical Disparity

Evaluation of Stereo Calibration Accuracy

Accuracy measure

- Vertical disparity d_y in rectified images

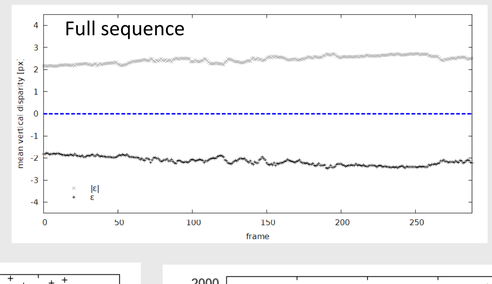
$$\epsilon = \frac{1}{n}\sum_{i=1}^{n} d_y^{(i)} \qquad |\epsilon| = \frac{1}{n}\sum_{i=1}^{n} |d_y^{(i)}|$$

Measurement method

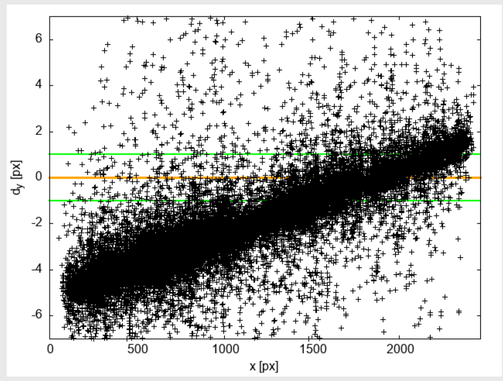
- Correspondence analysis in small search space
- A-KAZE features/descriptors

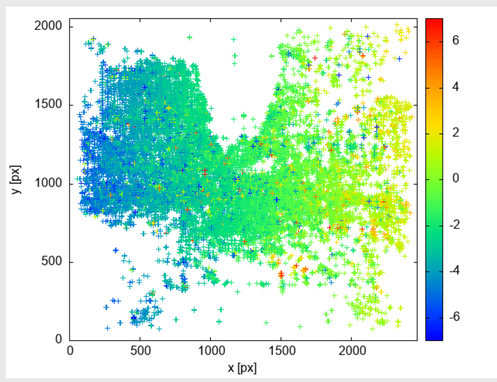
Observations

- Systematic error: $d_y \neq 0$
- Bad for classical stereo approaches, e.g., SGM
- AI models learn erroneous camera configuration



Argoverse 1.1
Trainset 06





d_y for 25 image pairs

Calibration Parameter Optimization

Minimization of vertical disparities

- Cost function: $|\varepsilon|$
- Experiments: optimization of relative orientation

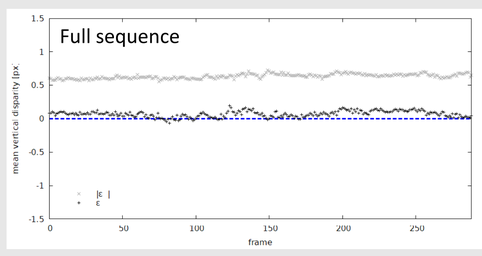
➢ (pan, tilt, roll) = (−0.00027°, 0.02195°, 0.16709°)

Elimination of systematic error

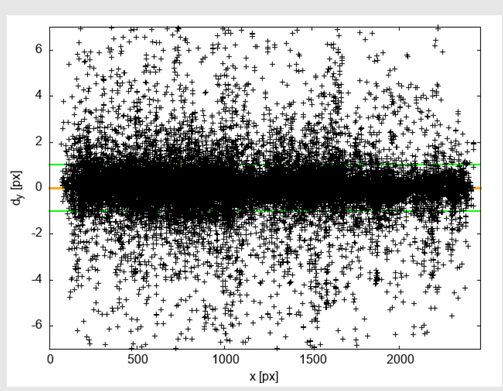
- Compute new rectified images

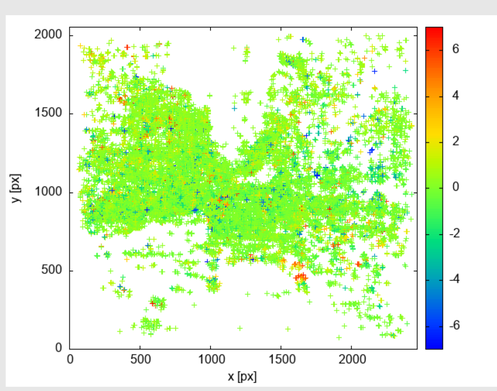
➢ Results Demonstration [YouTube]

Optimized



Argoverse 1.1
Trainset 06





d_y for 25 image pairs

Conclusions

Systematic errors in stereo datasets: Evaluated using correspondence analysis

➢ No calibration patterns needed for measurement

Error source: suboptimal stereo calibration

Optimization: Eliminates systematic error

➢ Enables *Online Calibration* -> avoids costly calibration procedure

Dataset	Calibration Evaluation
KITTI	OK, d_y < 0.25 px
Cityscapes	OK, d_y < 0.25 px
Driving Stereo	Marginal, d_y up to 1.5 px
DSEC	Marginal, d_y up to 1.5 px
ApolloScape	Erroneous, d_y up to 5 px
Argoverse 1.1	Erroneous, d_y up to 5 px

VISCODA GmbH
Dr.-Ing. Kai Cordes
cordes@viscoda.com
http://www.viscoda.com/research

VISCODA