

Bildverarbeitung für die Medizin, 2011-03-21, Lübeck

Lorenz KÖNIG¹, José Maria RAYA GARCIA DEL OLMO^{2,3}

Kantenaberration in der MRT

Zur Korrigierbarkeit von Lokalisierungsfehlern bei der Subvoxel-Kantendetektion

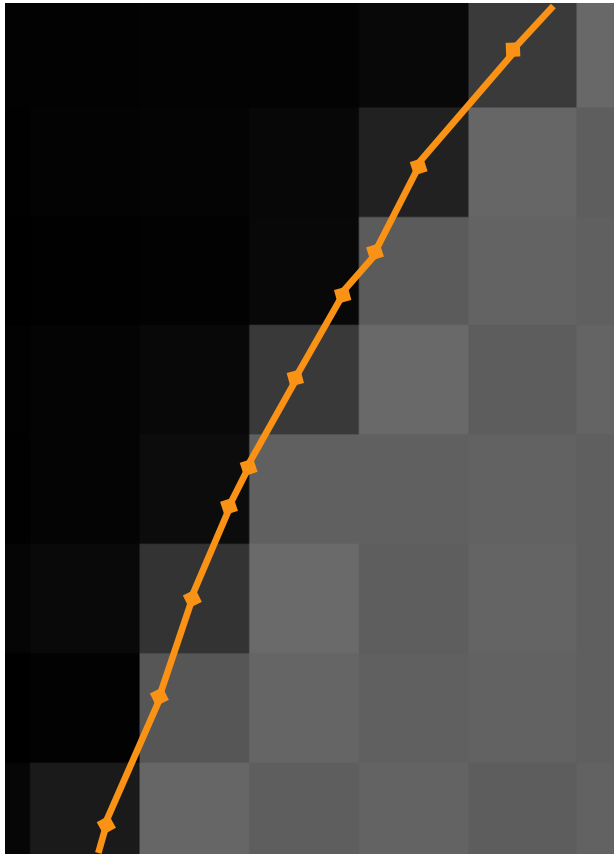
*Edge Aberration in MRI
Correction of Dislocations in
Sub-Voxel Edge Detection—
a Proof of Concept*

¹ Chair for Computer Aided Medical Procedures and Augmented Reality (CAMP), TU München

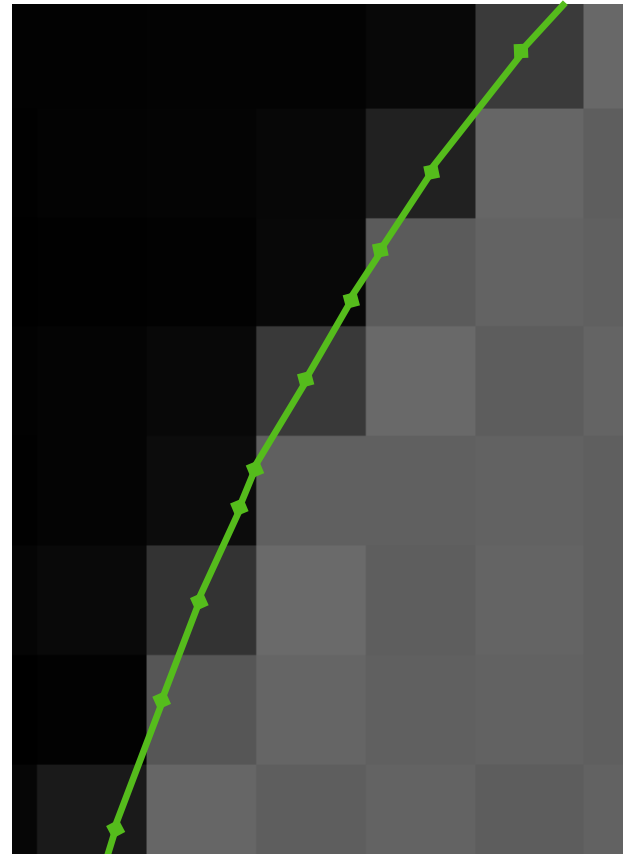
² NYU Langone Medical Center, New York University

³ Institut für klinische Radiologie, Ludwig-Maximilians-Universität München

Kantenaberration und -korrektur



Edge Aberration and Correction



Gliederung

Outline

- Kontext
 - Untersuchung der Kantenaberration
 - Ein Korrekturansatz
 - Herleitung
 - Kalibrierung
 - Evaluation
 - Zusammenfassung
- *Context*
 - *Analysis of Edge Aberration*
 - *An Approach for Correction*
 - *Derivation*
 - *Calibration*
 - *Evaluation*
 - *Conclusion*

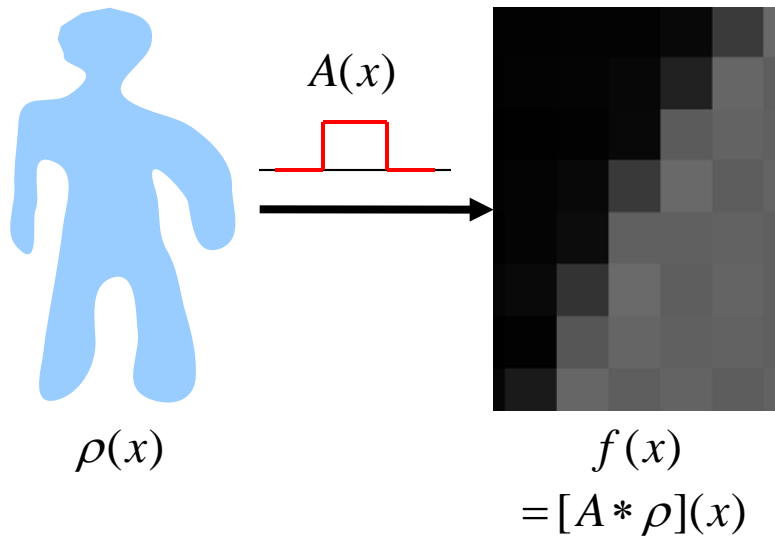
Rasterbildentstehung

Raster Image Formation

Gegenstand

Rasterbild

Bildentstehung

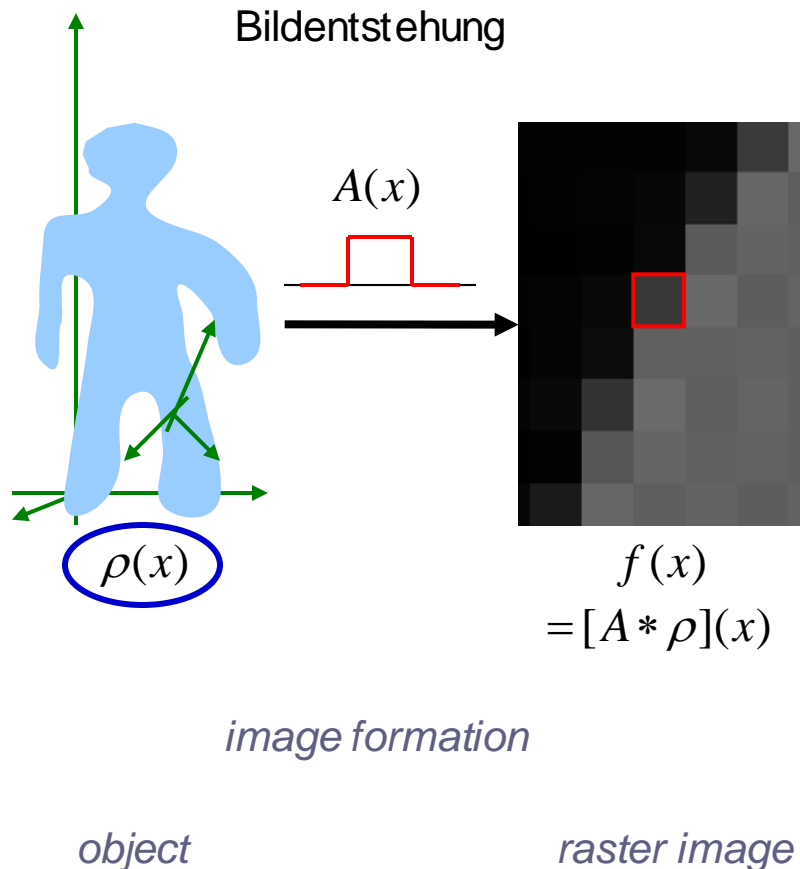
*image formation**object**raster image*

Rasterbildsemantik

Raster Image Semantics

Gegenstand

Rasterbild



Bildsemantik

- geometrisch – „wo?“
- physikalisch – „was?“
- „lokal“ (Voxelapertur)

Image Semantics

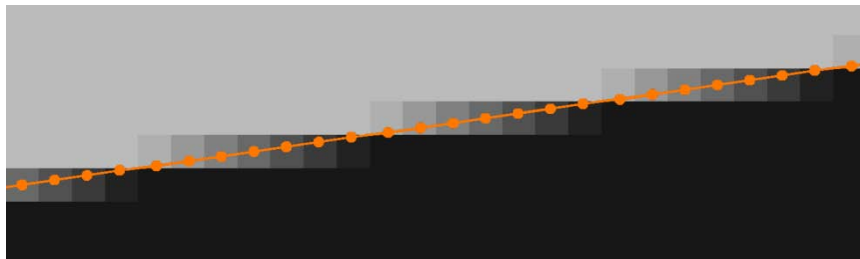
- *geometrical*—“where?”
- *physical*—“what?”
- “*local*” (*voxel aperture*)

Subvoxel-Kantendetektion

Sub-Voxel Edge Detection

synthetische Daten

synthetic data



Subvoxel-Kantendetektion

Sub-Voxel Edge Detection

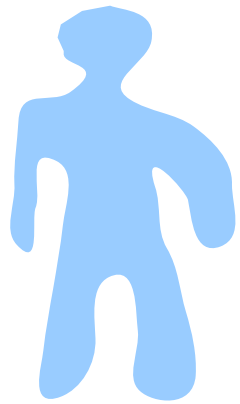
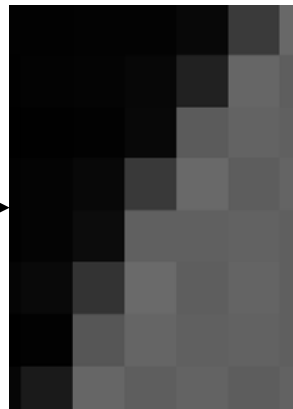
Gegenstand

Rasterbild

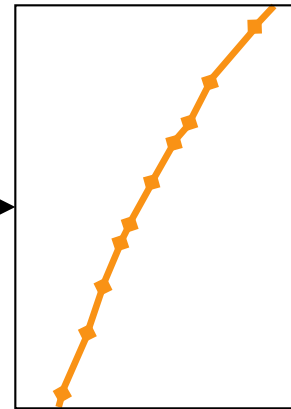
Kanten

Bildentstehung

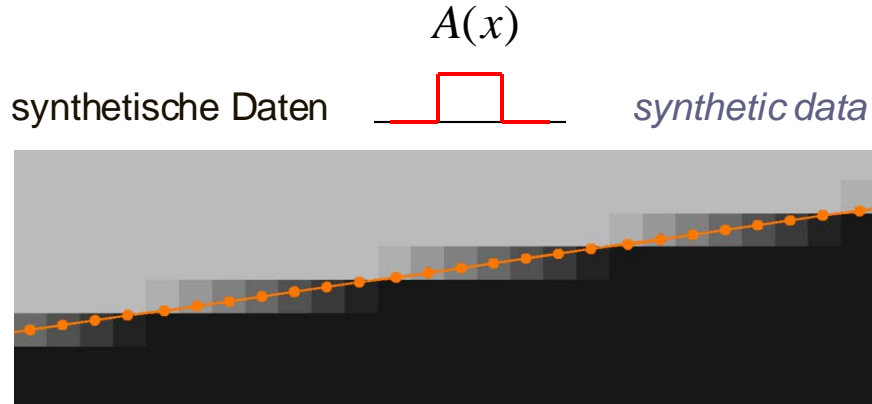
Kantendetektion

 $\rho(x)$ 

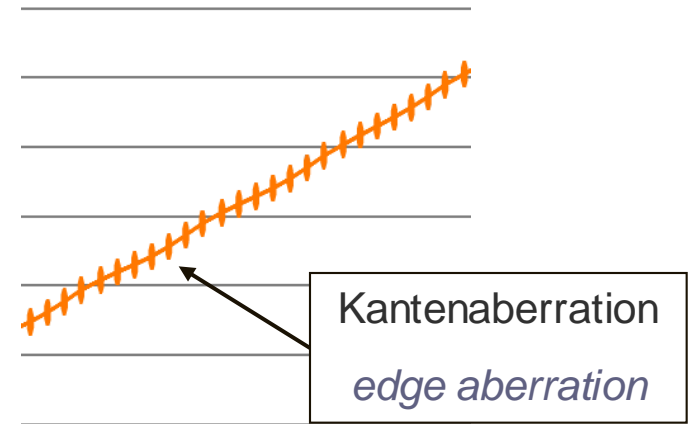
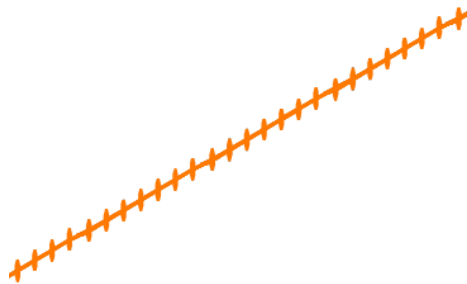
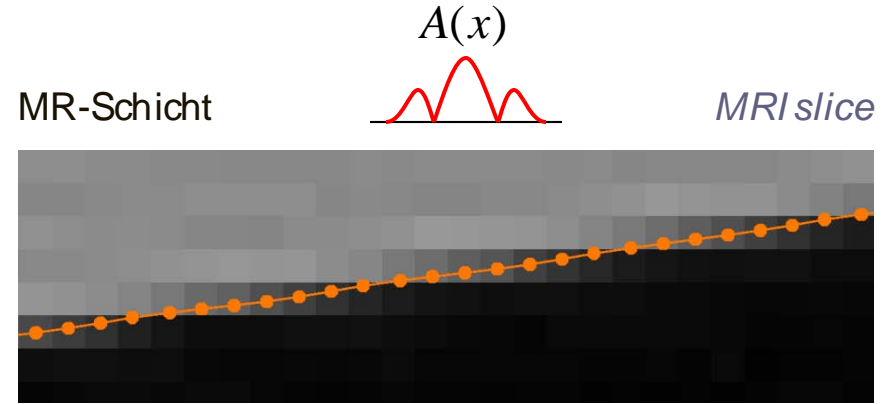
$$f(x)$$

$$= [A * \rho](x)$$
*image formation**edge detection**object**raster image**edges*

Subvoxel-Kantendetektion

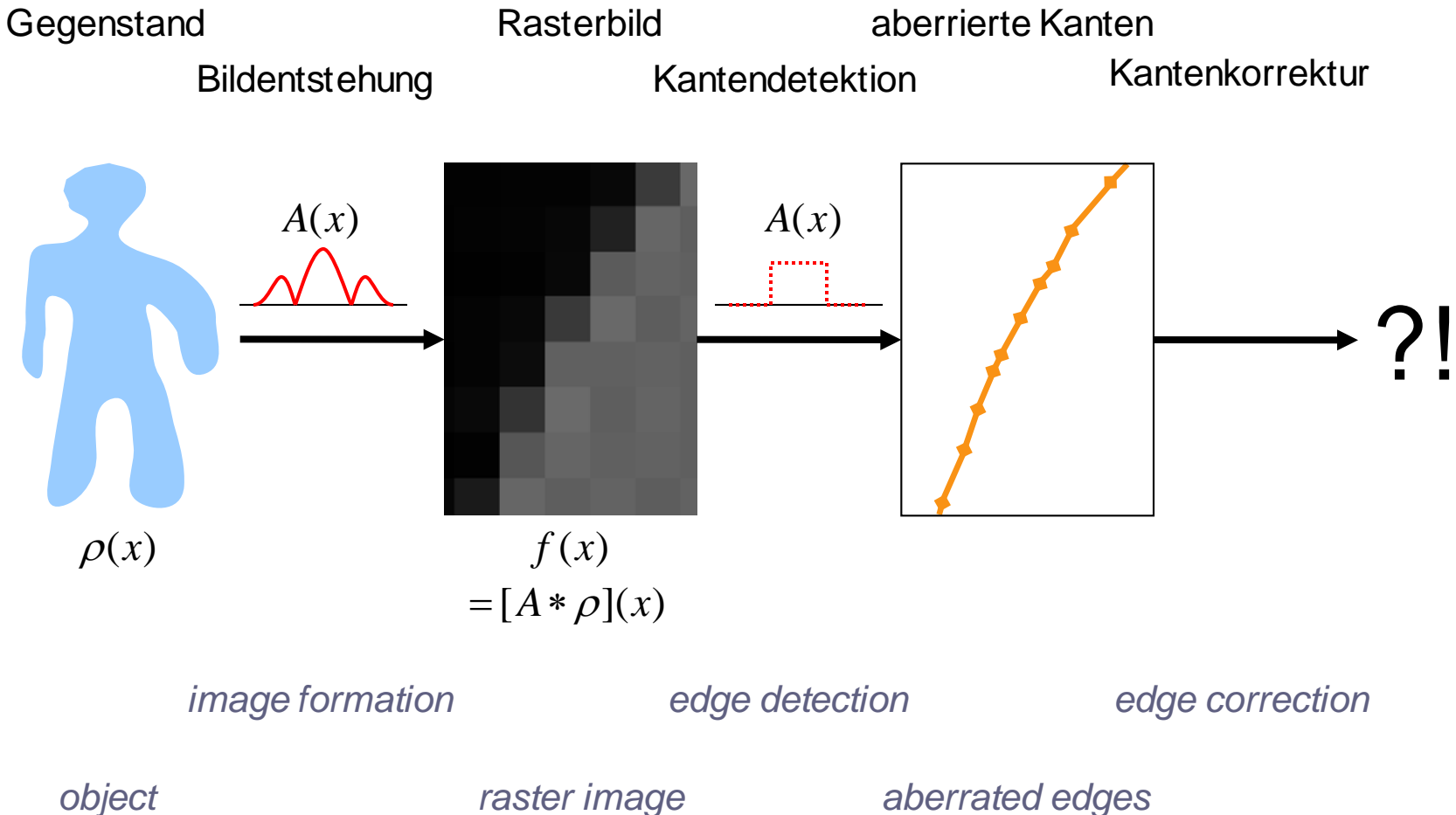


Sub-Voxel Edge Detection



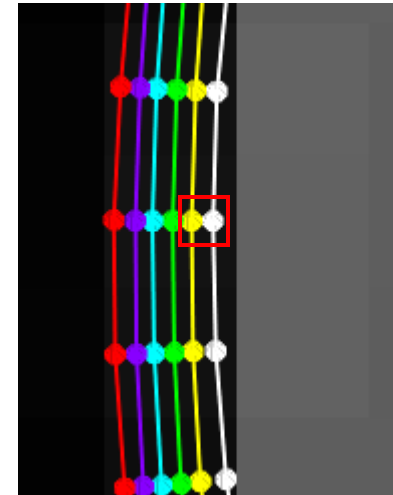
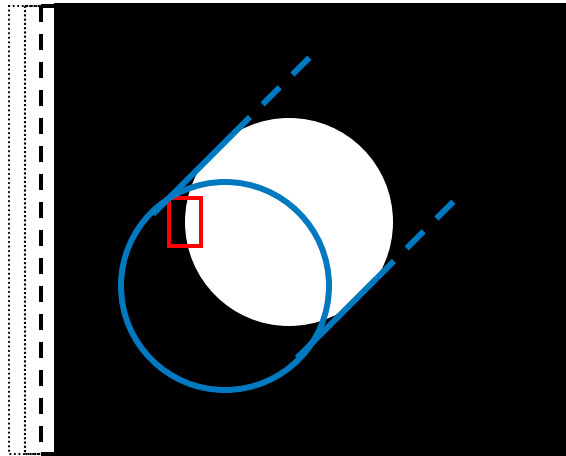
Kantenaberration als Bildsemantikproblem

Edge Aberration as an Image Semantics Problem



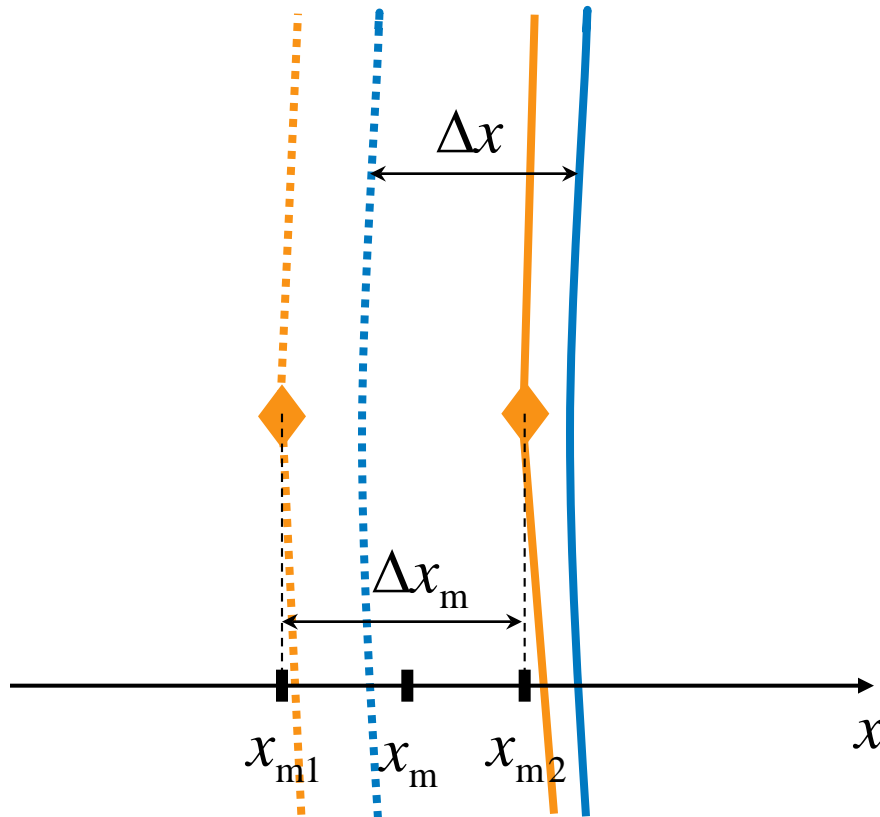
Messung – Subvoxel-Verschiebung eines Kantenphantoms

Measurement— Sub-Voxel Translation of an Edge Phantom



Messung – Kantenverschiebungsfehler

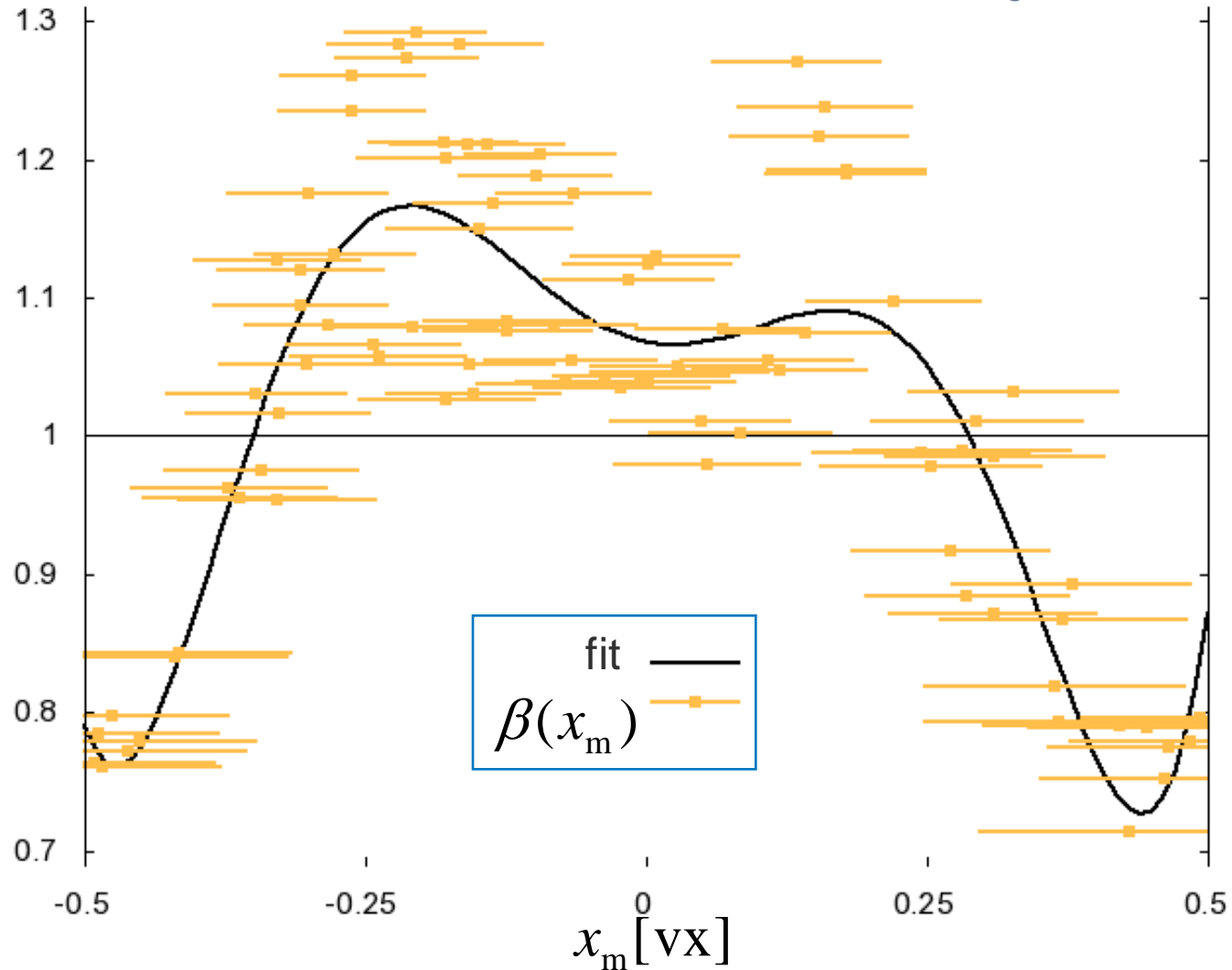
Measurement— Edge Offset Error



$$\frac{\Delta x}{\Delta x_m} =: \beta$$

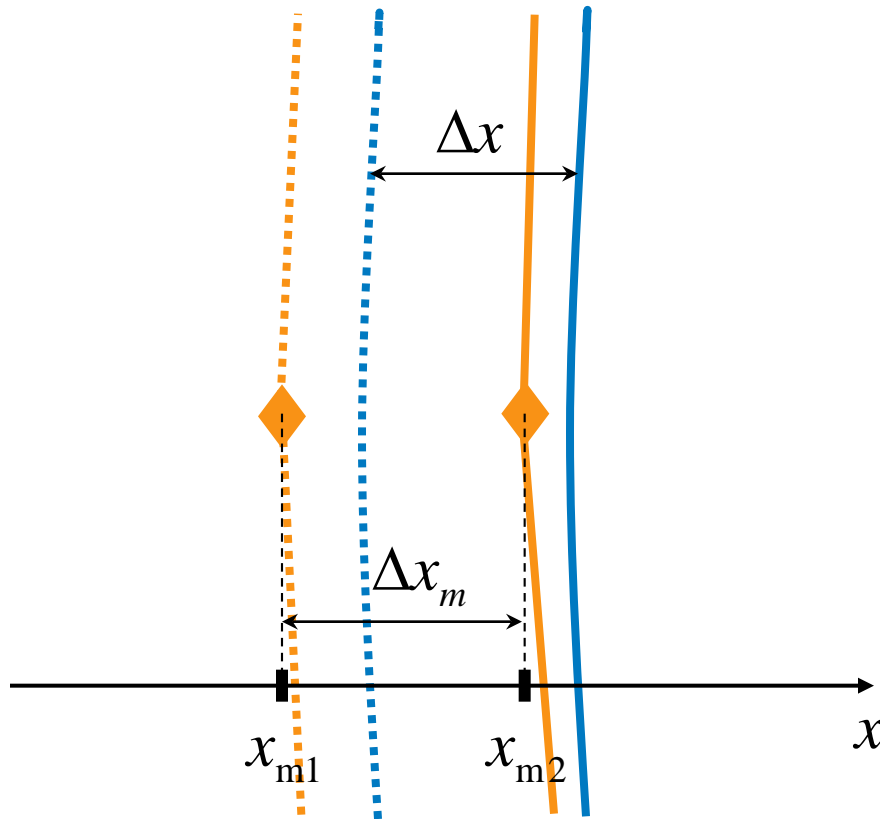
Systematische Fehler

Systematic Errors



Herleitung des Korrekturterms

Derivation of a Correction Term

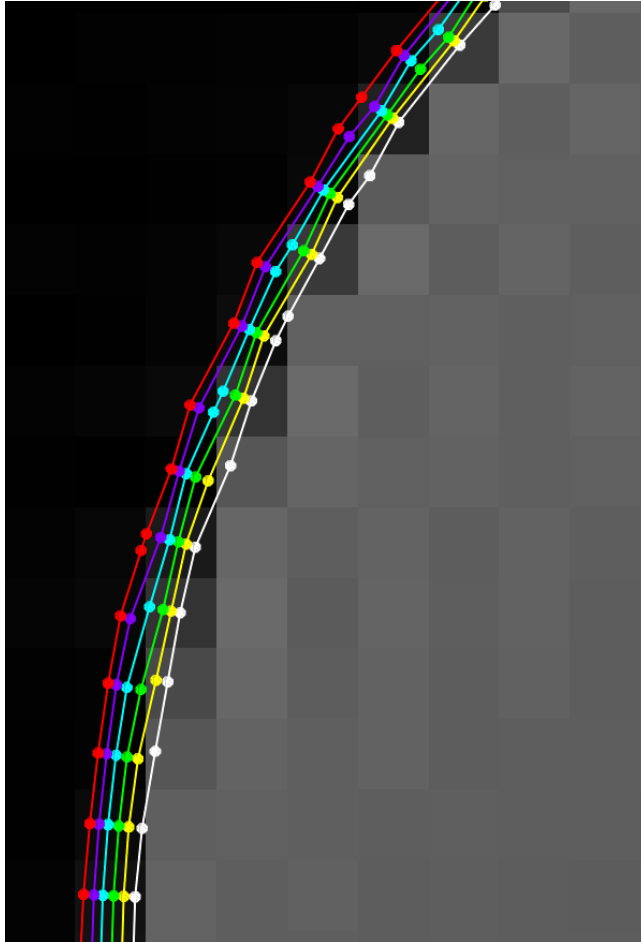


$$\frac{\Delta x}{\Delta x_m} =: \beta(x_m)$$

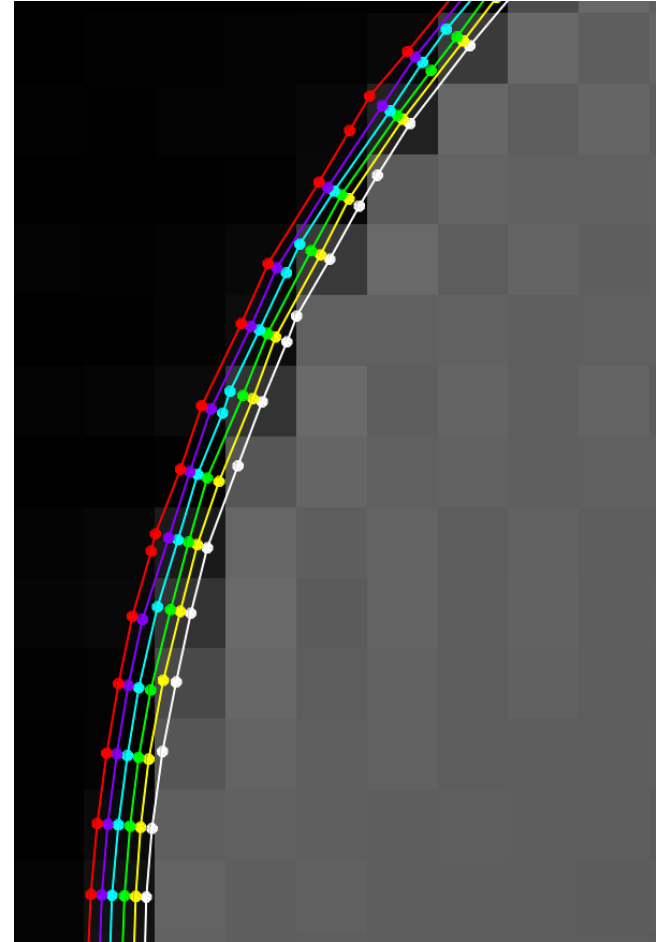
$$\Rightarrow \frac{dx}{dx_m} \approx \beta(x_m)$$

$$\Rightarrow x(x_m) \approx \int \beta(x_m) dx_m$$

Kantenkorrektur – Visuelle Evaluation

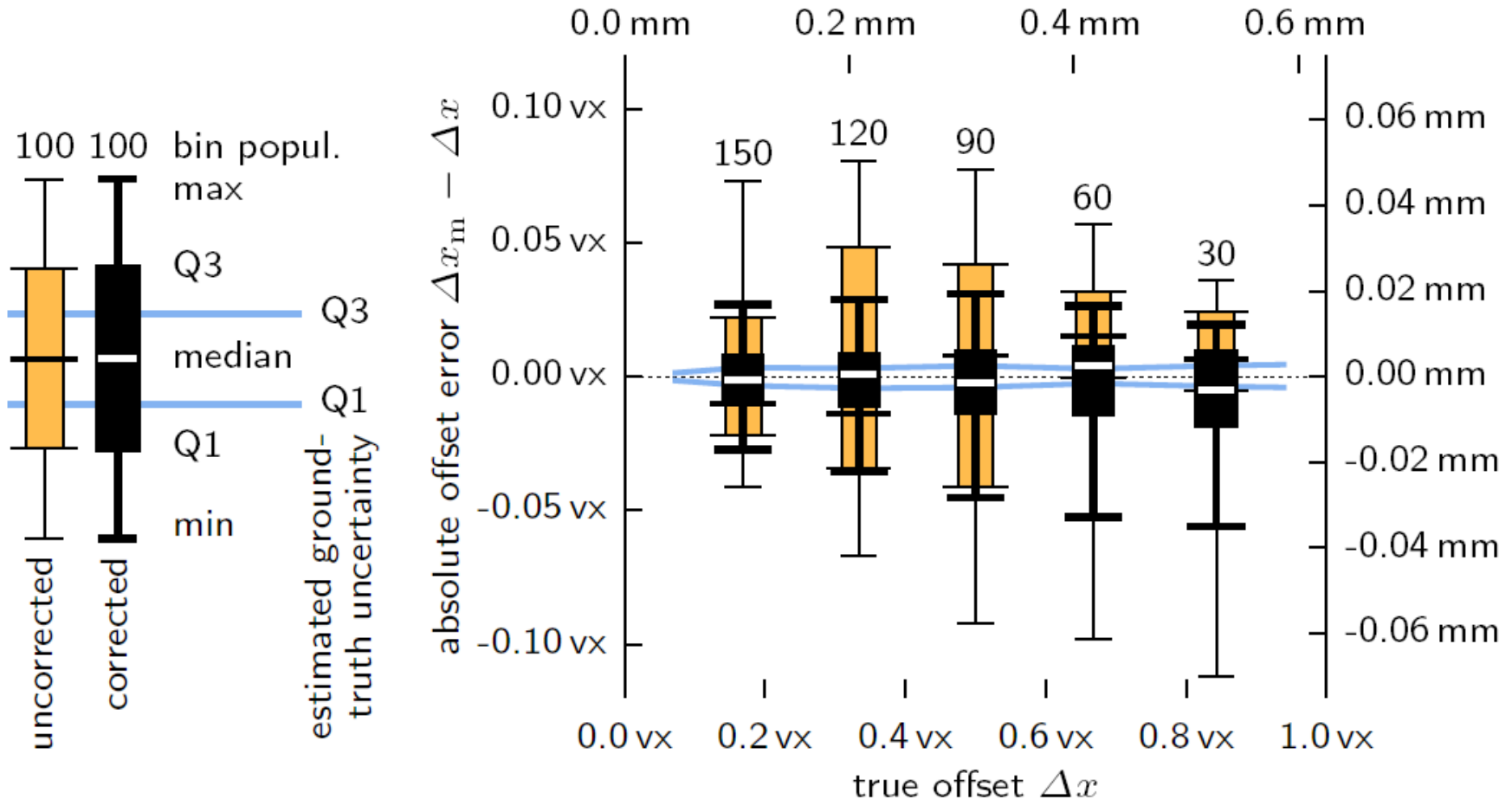


Edge Correction— Visual Evaluation



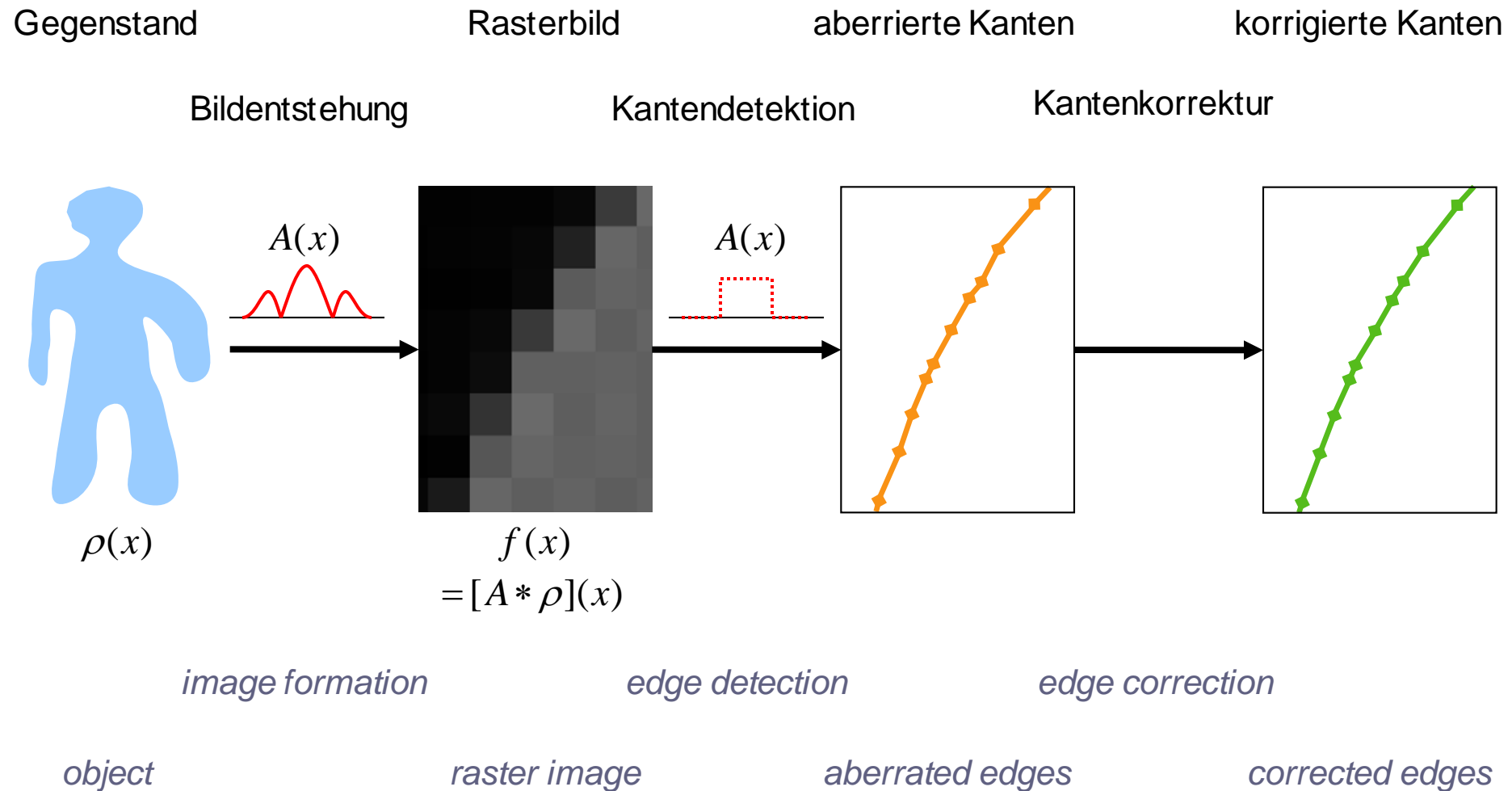
Kantenkorrektur – Quantitative Evaluation

Edge Correction— Quantitative Evaluation



Gesamtschema

Overall Schematic



Zusammenfassung

- **Beobachtungen**
 - Kantenaberration nicht kantendetektorbedingt
 - Kantenaberration ist systematisch
 - Korrekturterm kalibrierbar
 - Kantenaberration reduzierbar
- **Deutung**
 - Bildfehlinterpretation (Voxelapertur)
- **Folgerungen**
 - Kantendetektoren anpassen
 - Bildsemantik (Voxelapertur) in Metadaten aufnehmen

Conclusion

- *Observations*
 - *Edge aberration not due to edge detector*
 - *Edge aberration is systematic*
 - *Correction term can be calibrated*
 - *Edge aberration can be reduced*
- *Interpretation*
 - *Image mis-interpretation (voxel aperture)*
- *Conclusions*
 - *Adapt edge detectors*
 - *Incorporate image semantics (voxel aperture) in image meta data*

imaging@l-koenig.com