

# Medical Image Processing for Diagnostic Applications

## IH Correction – Examples and Further Applications

Online Course – Unit 26

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Pattern Recognition Lab (CS 5)



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## Bias Field Estimation: Examples

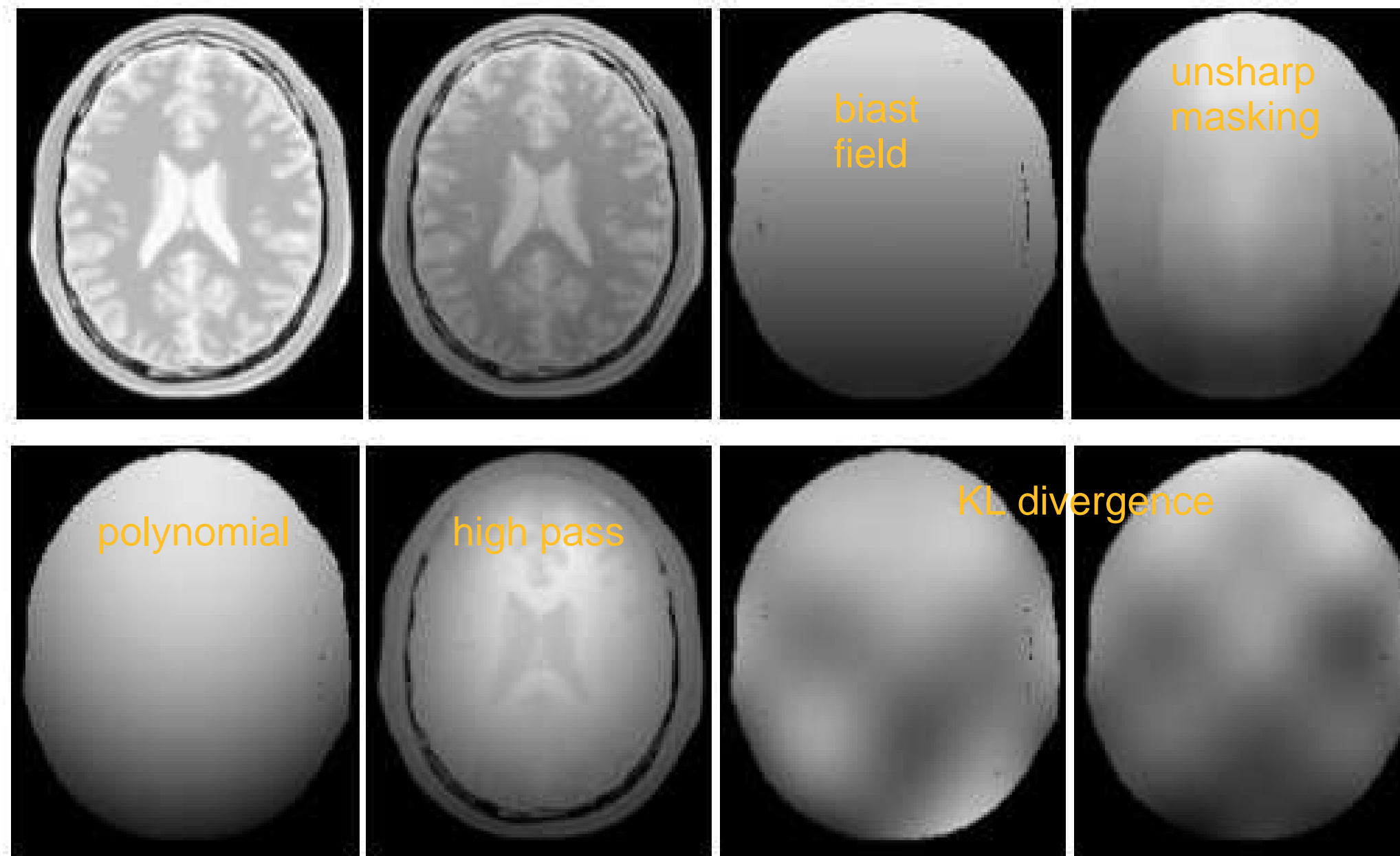


Figure 1: First row, from left to right: reference image, biased image (3% noise, 50% bias), original bias field, homomorphic unsharping mask. Second row: polynomial fit (degree 4), high pass filter, KL divergence with reference from original image, KL divergence with reference from high pass filter.

## Fuzzy C-means **Clustering**: Image Examples

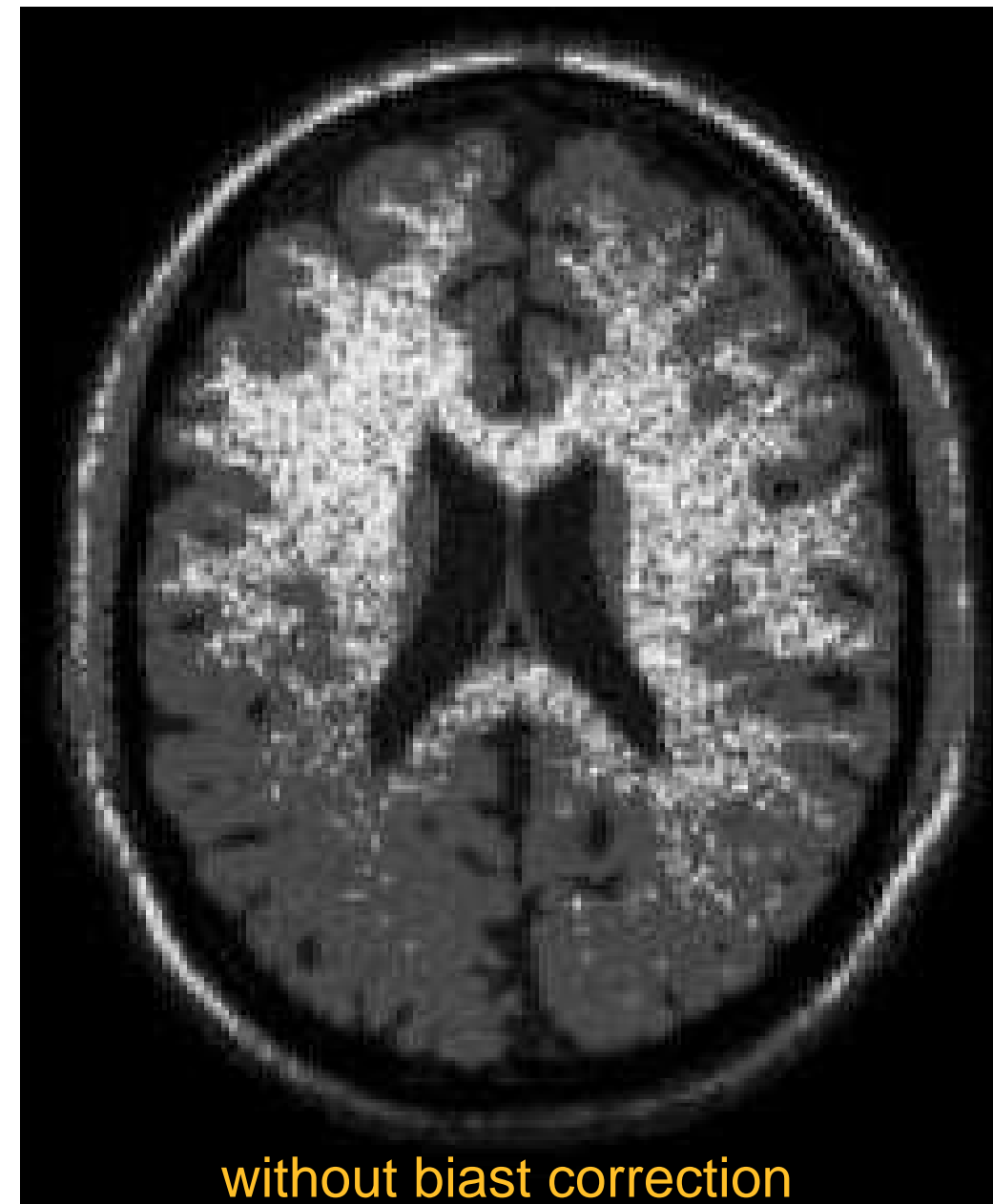


Figure 2: Comparison of segmentation results (from left to right): T1 weighted MR phantom image, fuzzy C-means algorithm without regularization, fuzzy C-means with regularization (cf. [Ahmed et al.](#))

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## Further Applications of IIH

- X-ray imaging: correction of the heel effect (see further readings)
- Endoscopy/retina imaging: correction of heterogeneous illumination
- Ultrasound imaging: correction of signal decay with distance from probe and correction of shadows



## Further Applications of IIH

**Bias correction** in retina image processing:

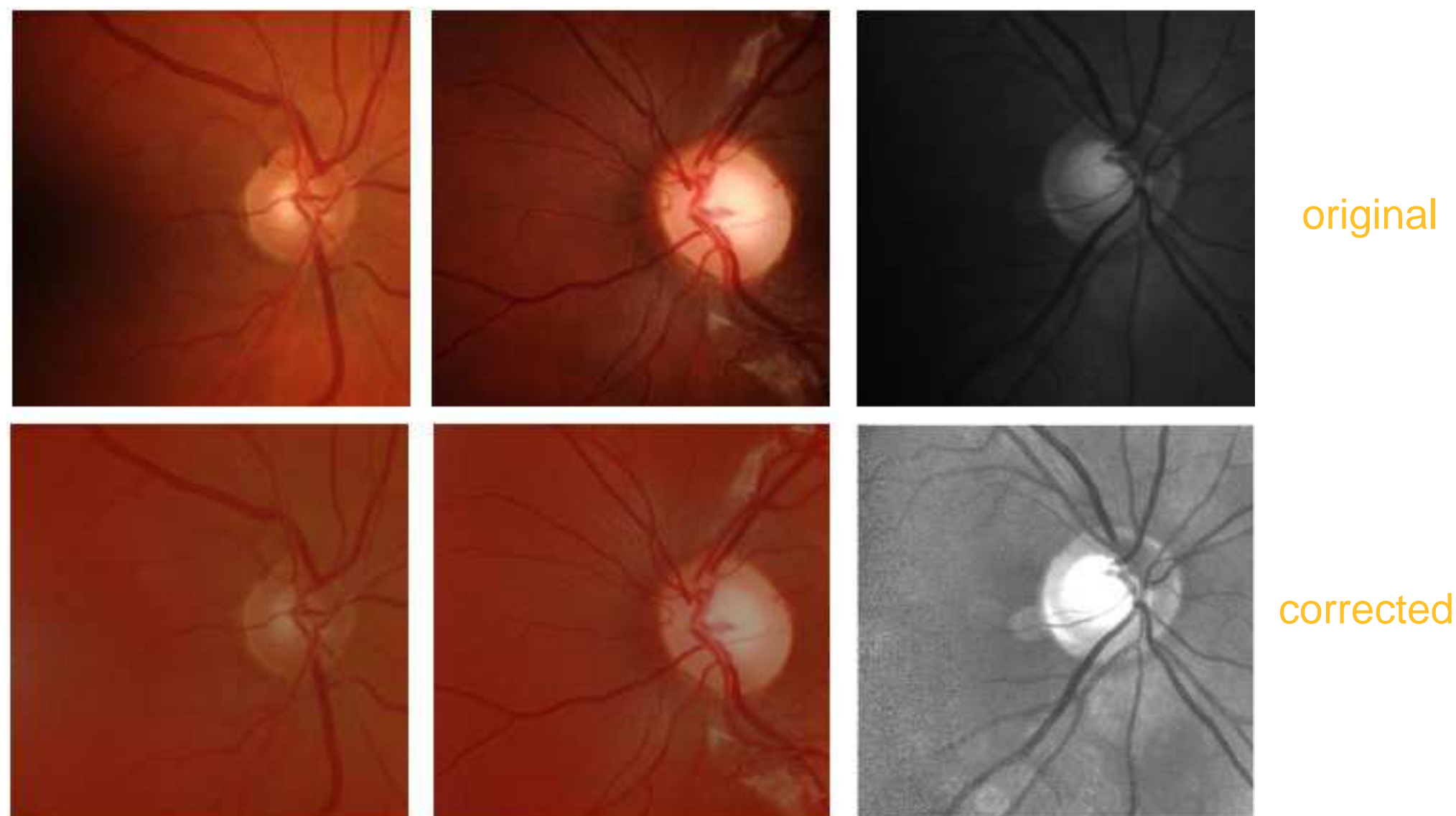
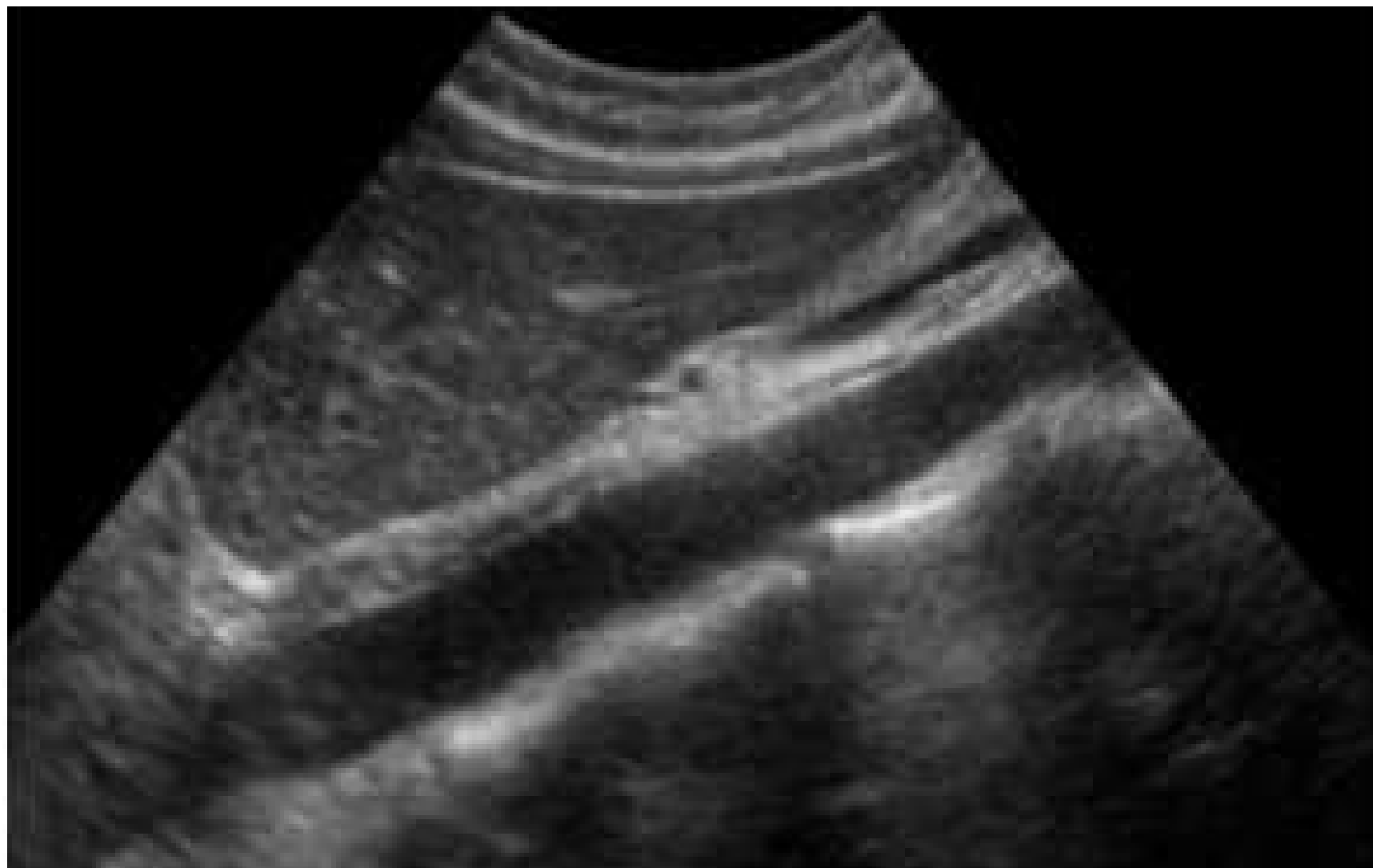


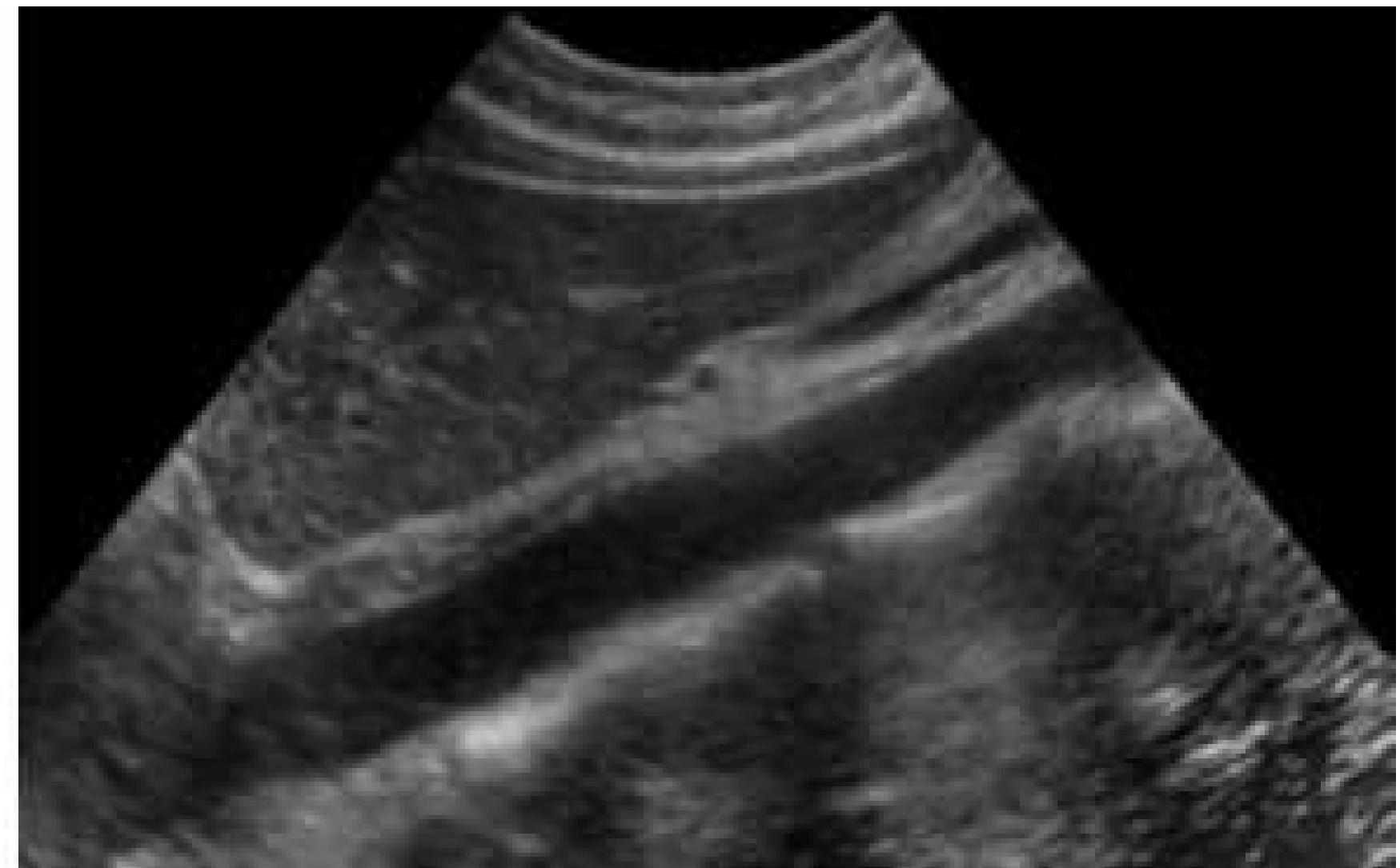
Figure 3: Retina images with **heterogeneous illumination** (upper row), bias corrected images (surface fitting method, degree 4 polynomials, lower row).

## Further Applications of IIH

Bias correction in ultrasound imaging:



gets darker towards the bottom



corrected

Figure 4: Ultrasound image with decreasing signal from top to bottom (left), bias corrected image (surface fitting method, degree 1 polynomial, right)



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The correction methods introduced in this course extend their usefulness to other modalities than MRI as well.

## Further Readings

The original paper on which the discussion in this unit is based on is:

**Mohamed N. Ahmed et al.** “A Modified Fuzzy C-Means Algorithm for Bias Field Estimation and Segmentation of MRI Data”. In: *IEEE Transactions on Medical Imaging* 21.3 (Mar. 2002), pp. 193–199. DOI: [10.1109/42.996338](https://doi.org/10.1109/42.996338)

How the heel effect can be corrected, is described in the following paper:

**Gert Behiels et al.** “Retrospective Heel Effect Correction in Conventional Radiography”. In: *IEEE Workshop on Mathematical Methods in Biomedical Image Analysis, 2001*. IEEE, Dec. 2001, pp. 87–94. DOI: [10.1109/MMBIA.2001.991703](https://doi.org/10.1109/MMBIA.2001.991703)