Medical Image Processing for Diagnostic Applications

Defect Pixel Interpolation – Examples

Online Course – Unit 18

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Topics

Examples

Applications

Summary
- Take Home Messages
- Further Readings

Interpolation Results

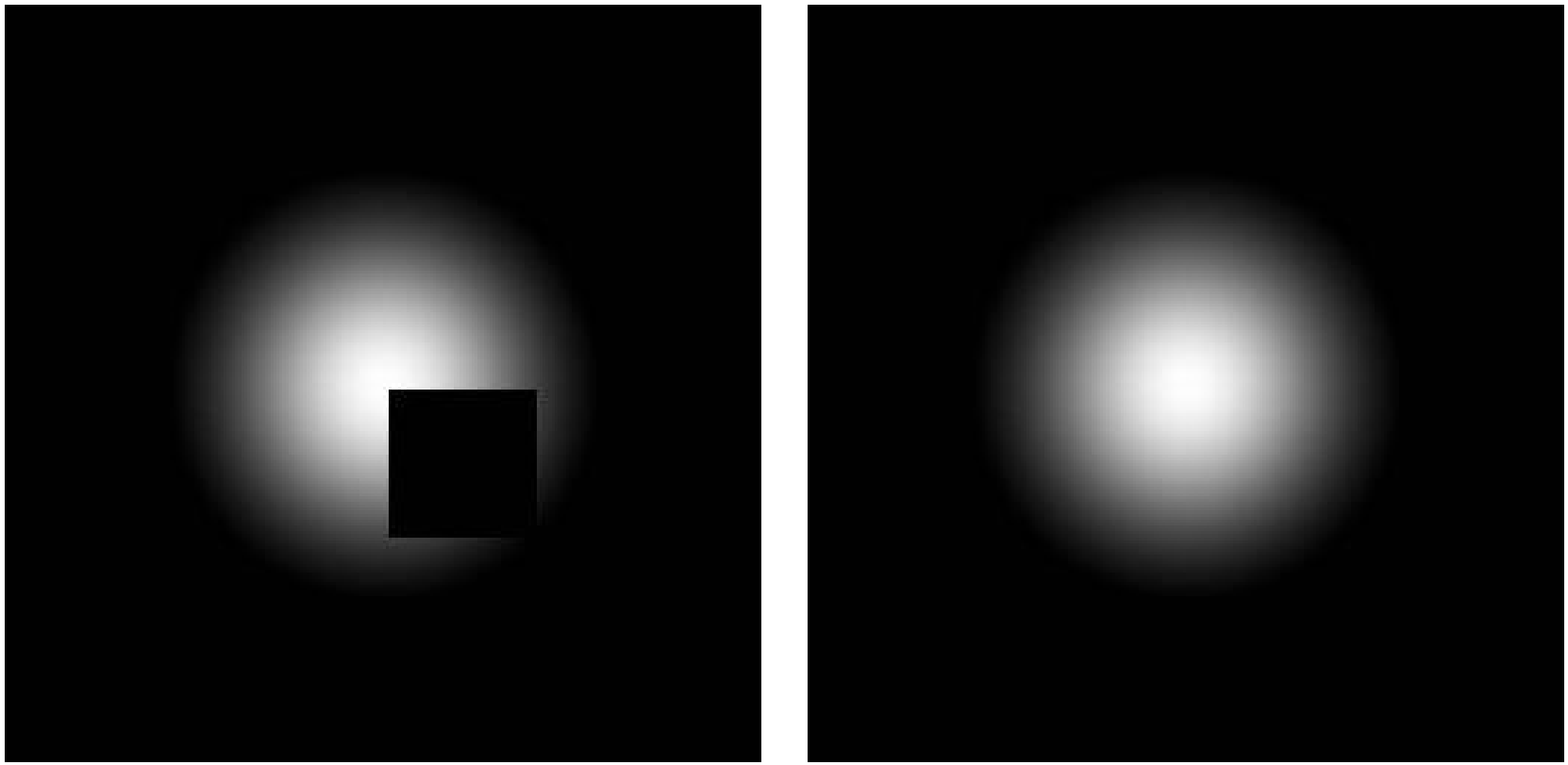


Figure 1: Synthetic image with a square artifact (left) and the result after 100 iterations (right)

Interpolation Results

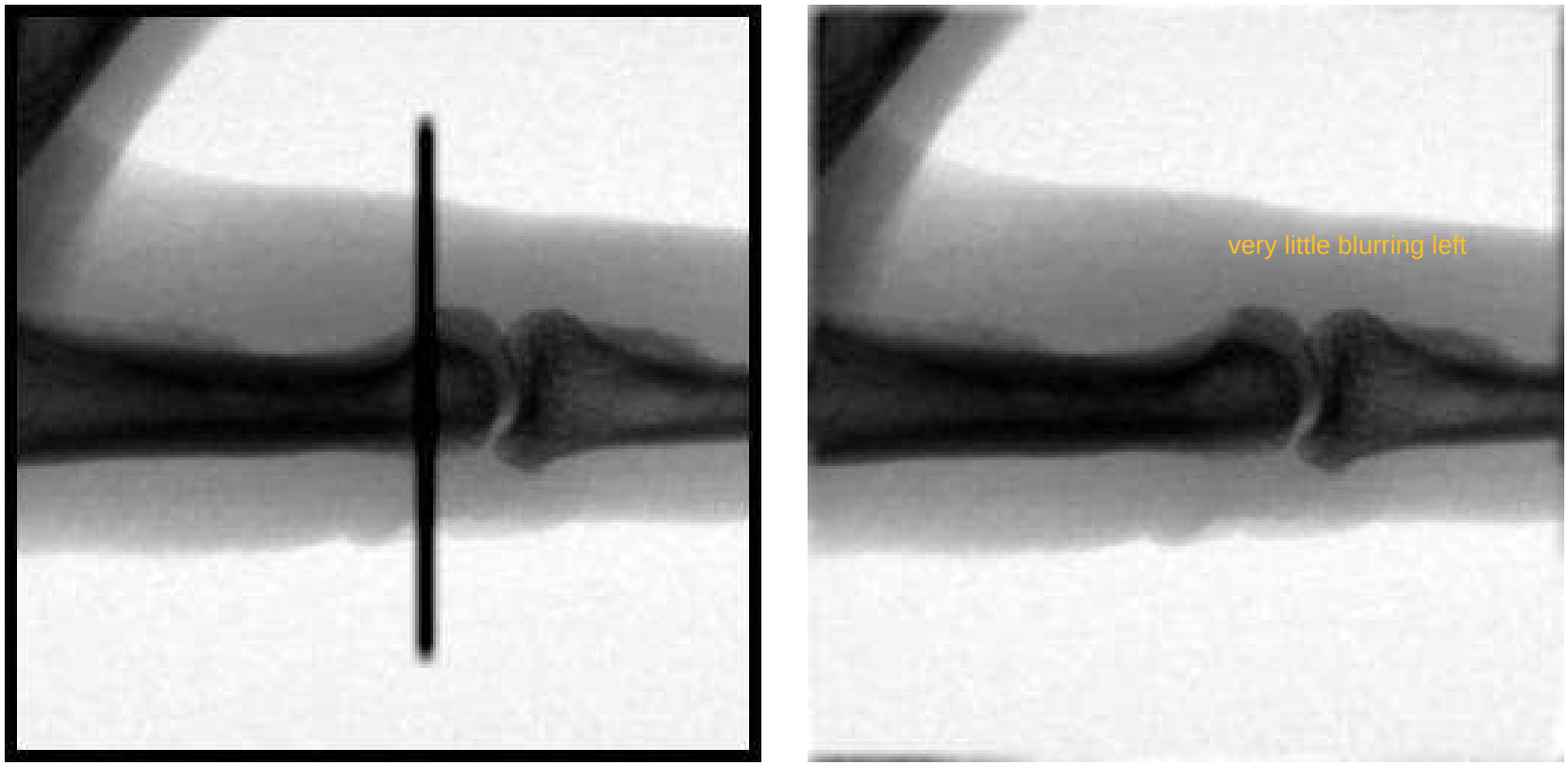


Figure 2: Original image including defects (left) and the result after 500 iterations (right)

Interpolation Results

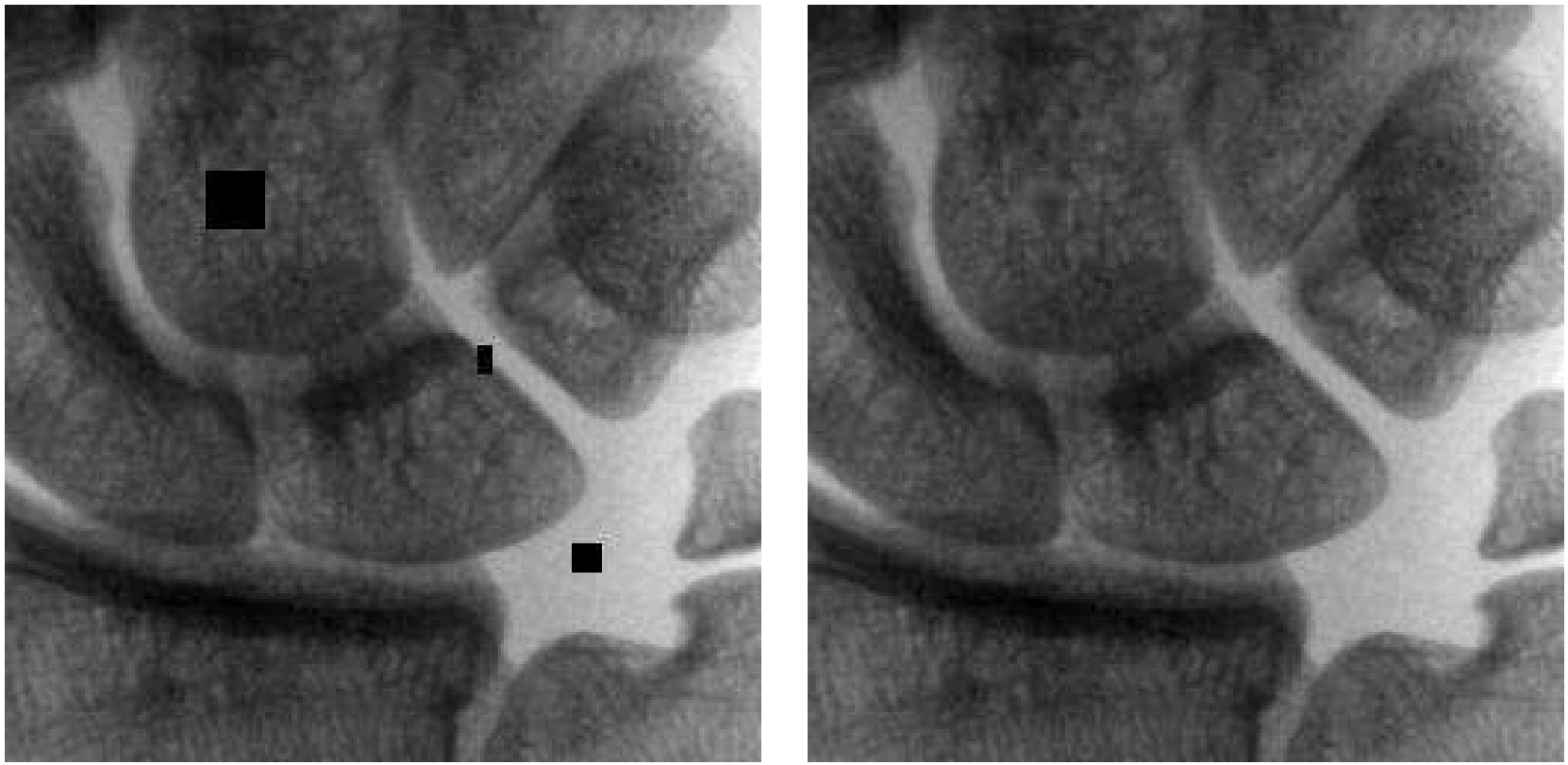


Figure 3: X-ray image with defects (left) and the result of interpolation after 500 iterations (right)

Interpolation Results

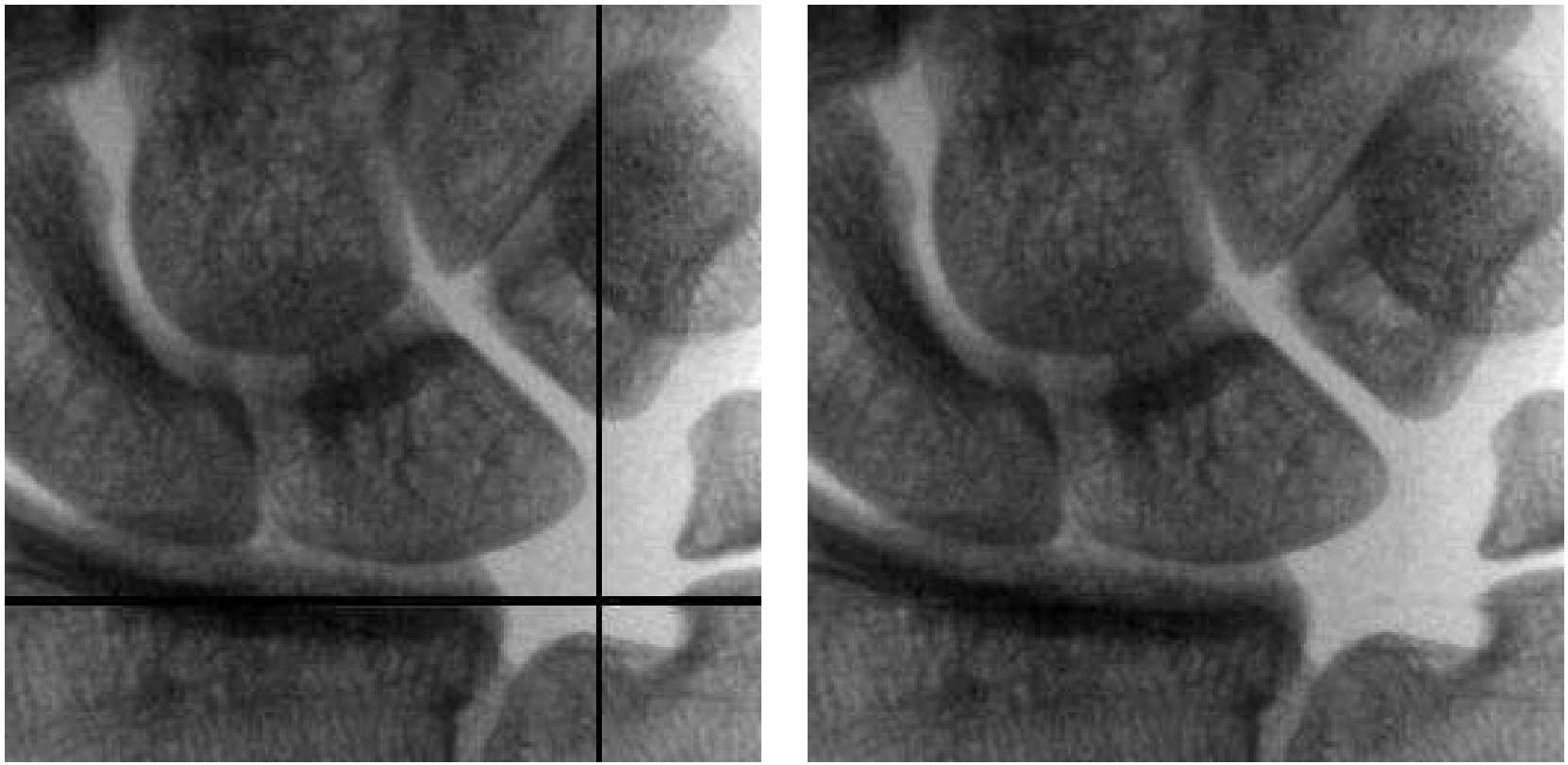


Figure 4: X-ray image with defects (left) and the result of interpolation after 1000 iterations (right)

Interpolation Results

since we work in frequency domain we can even recover noise

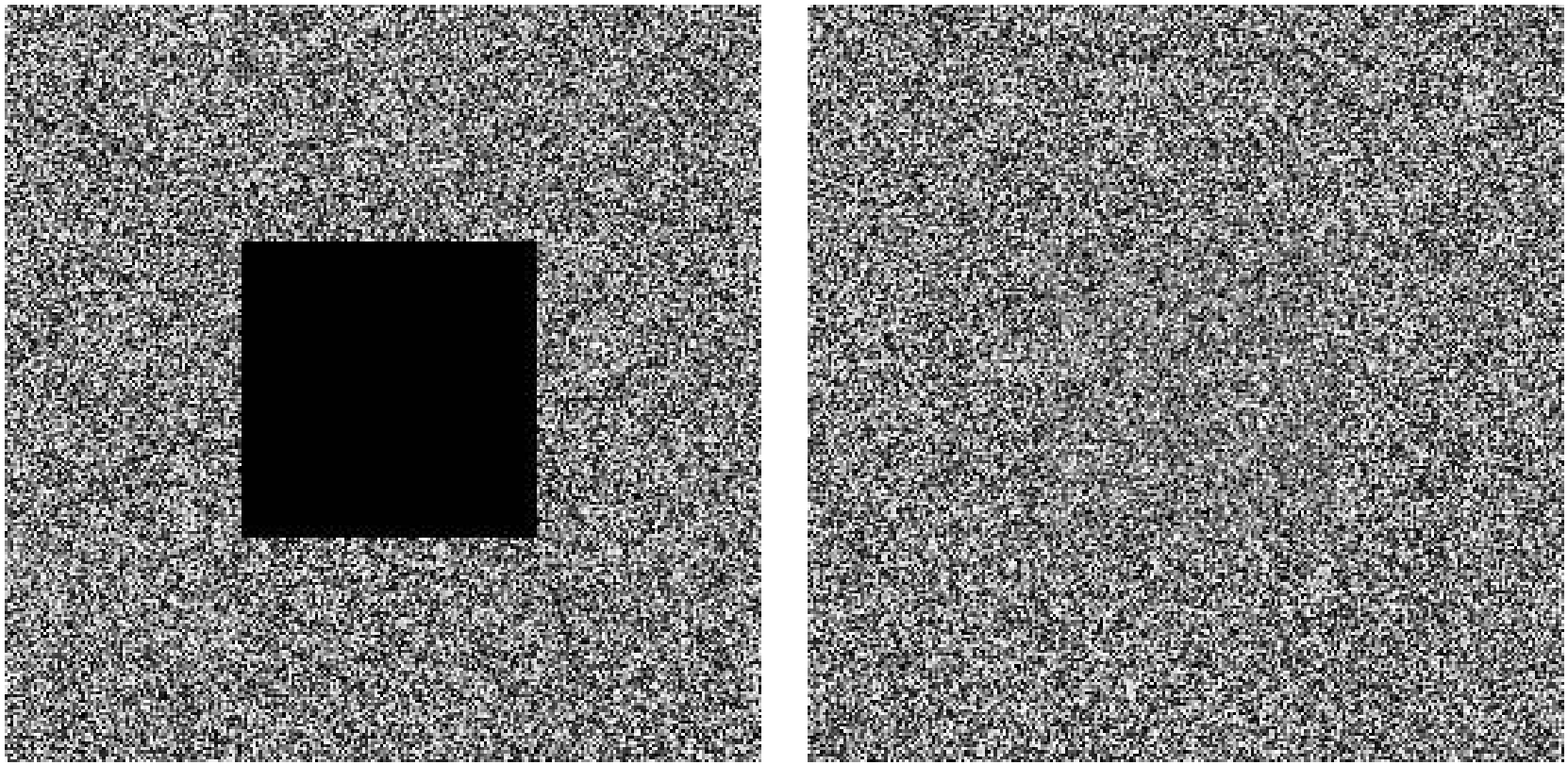
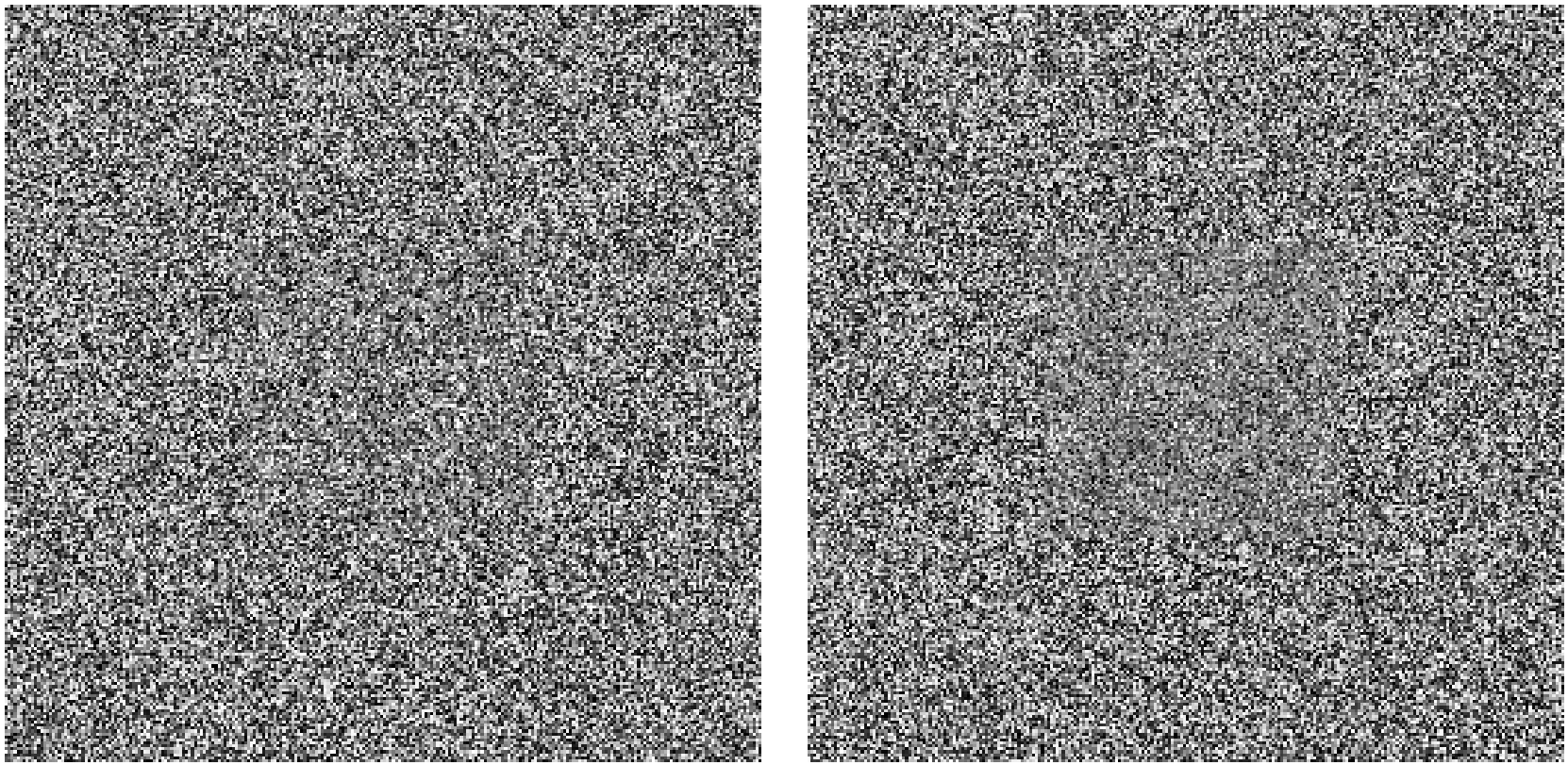


Figure 5: Artificial noise image with defect pixels (left) and the result of interpolation after 1000 iterations (right)

Interpolation Results



over-iteration ?

Figure 6: Result of interpolation after 1000 (left) and 5000 iterations (right)

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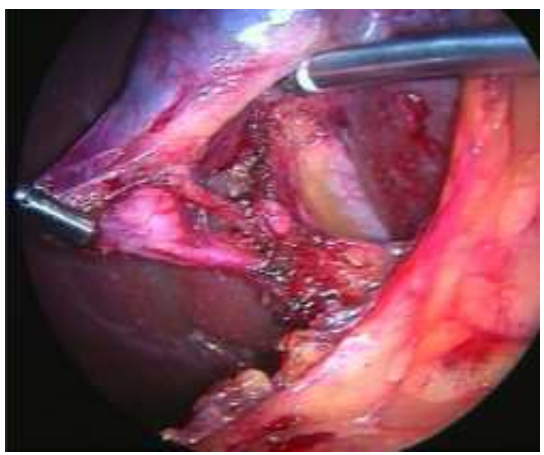
Application to Endoscopy

shiny parts saturate sensor :(

- Endoscopy: wet surfaces lead to specular reflections
- Segmentation of highlighted areas
- Apply defect interpolation



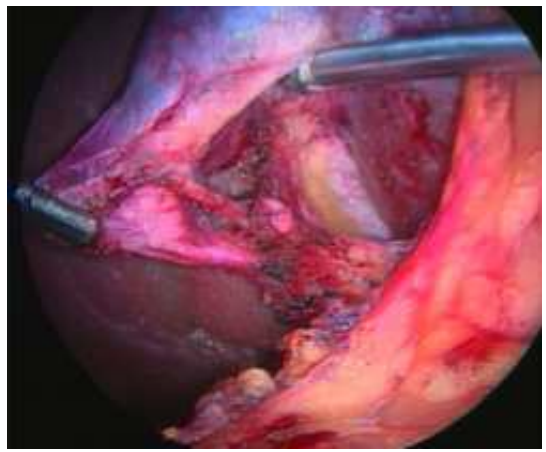


Figure 7: Endoscopy image with reflections, segmentation result, and result of interpolation (image courtesy of Xie Weiguo)

Application to Ophthalmology

Color images in Ophthalmology

- In Ophthalmology the early diagnosis of diseases is done on the basis of retina images.
- For the diagnosis of Glaucoma disease, sometimes vessel structures are less important and misleading.

we only want to see the shape of the disc

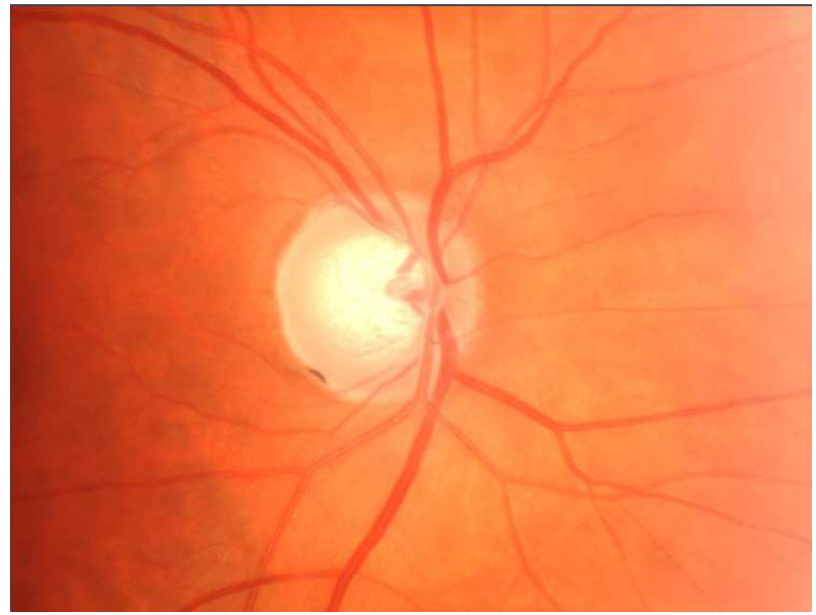


Figure 8: Color image of retina showing also the papilla, veins and arteries

Application to Ophthalmology

Eliminate vessel structures: detect vessels and declare them defect pixels

- Perform a segmentation of vessels, i. e., identify all image points that belong to a vessel.
- Consider pixels of vessels as defects.
- Run a defect pixel interpolation algorithm on images with defects.

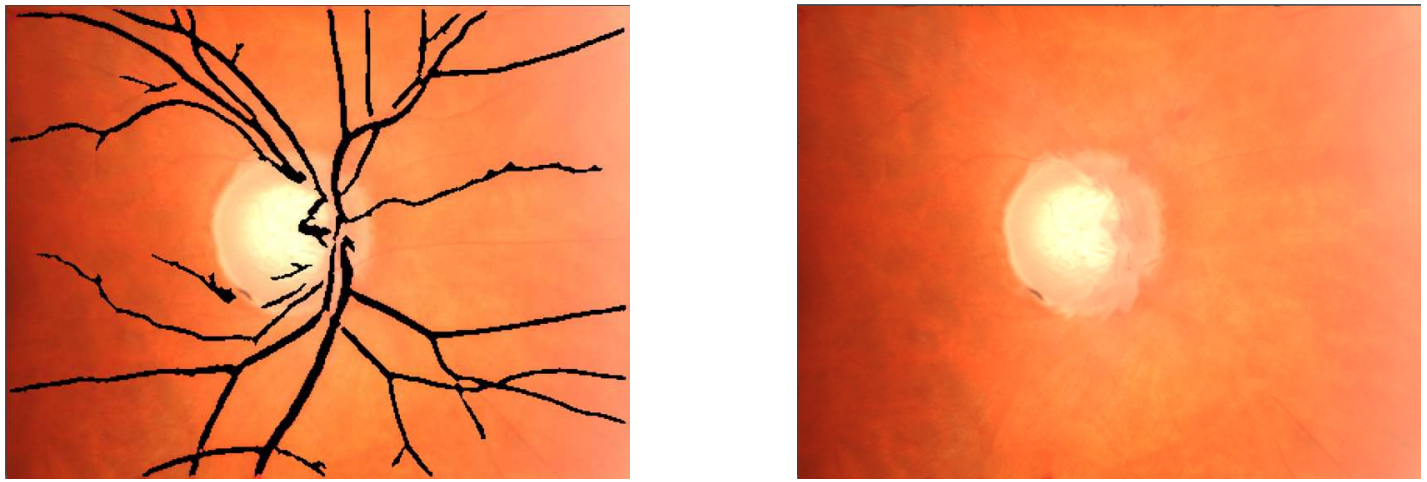
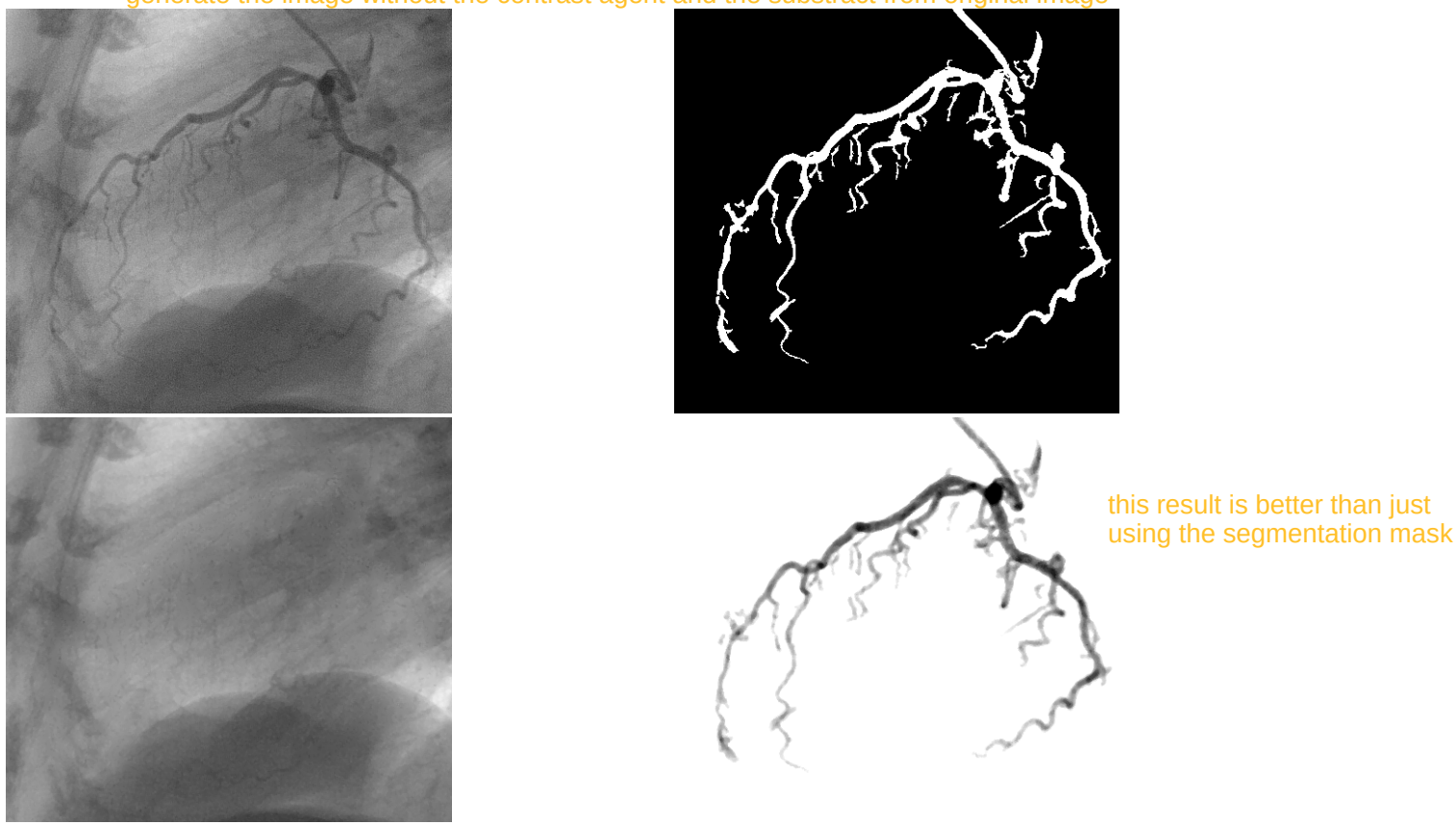


Figure 9: Segmented image (left) and image after defect pixel interpolation (right)

Application to CT Angiography

usualy u use digital substraction -> difficult for hearth since it is moving -> use the same algorithm as earlier to generate the image without the contrast agent and the substract from original image



this result is better than just using the segmentation mask

Figure 10: CT image showing heart scan (top left), segmentation (top right), inpainting (bottom left) and DSA (bottom right) (Mathias Unberath, Pattern Recognition Lab, FAU)

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Take Home Messages

- You have seen results of defect pixel interpolation.
- The methods from defect pixel interpolation are applied to many other problems in medical image processing.

Further Readings

- The method presented for defect pixel interpolation in the frequency domain was published by Til Aach and Volker Metzler in 2001:

  Til Aach and Volker Metzler. "Defect Interpolation in Digital Radiography: How Object-Oriented Transform Coding Helps". In: *Proc. SPIE 4322, Medical Imaging 2001: Image Processing*. Vol. 4322. San Diego, CA: SPIE, Feb. 2001, pp. 824–835. DOI: 10.1117/12.431161

- A recent article about defect pixel interpolation with respect to image quality issues can be found here:

  Jan Kuttig et al. "Effects of Defect Pixel Correction Algorithms for X-ray Detectors on Image Quality in Planar Projection and Volumetric CT Data Sets". In: *Measurement Science and Technology* 26.9 (Aug. 2015), 095406 (14pp). DOI: 10.1088/0957-0233/26/9/095406