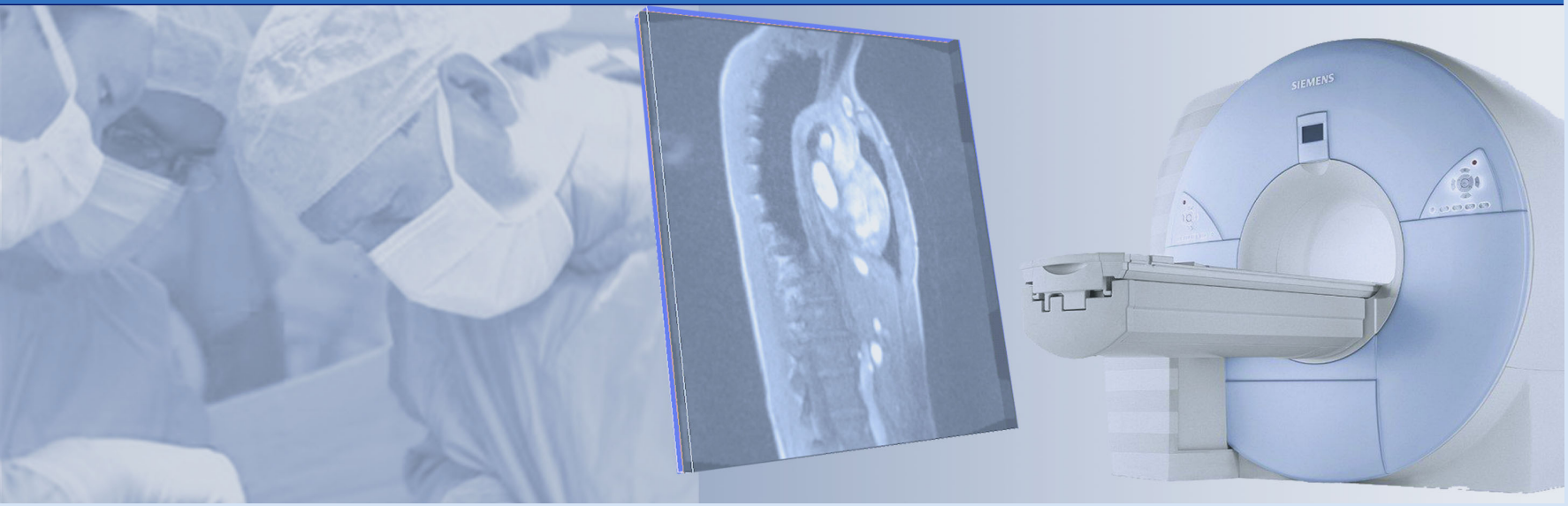
Tutorial Computer- and robot-assisted Surgery



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NATIONALES CENTRUM
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UNIVERSITÄTS KREBSCENTRUM UCC

getragen von:
Deutsches Krebsforschungszentrum
Universitätsklinikum Carl Gustav Carus Dresden
Medizinische Fakultät Carl Gustav Carus, TU Dresden
Helmholtz-Zentrum Dresden-Rossendorf

Sebastian Bodenstedt
Translational Surgical Oncology

Questions lecture

Review Segmentation

Threshold operations

- Point-based (no global features)
- Generation of a binary image

- Operator with threshold Θ

$$f \rightarrow h$$

$$h_{jk} = \begin{cases} 1 \text{ für } f_{jk} > \Theta \\ 0 \text{ sonst} \end{cases}$$

$$h_{jk} = \begin{cases} 1 \text{ für } \Theta_{\min} < f_{jk} < \Theta_{\max} \\ 0 \text{ sonst} \end{cases}$$

Threshold

- Threshold segmentation
  - Type :

THRESH_BINARY	$\texttt{dst}(x,y) = \begin{cases} \texttt{maxval} & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ 0 & \text{otherwise} \end{cases}$
THRESH_BINARY_INV	$\texttt{dst}(x,y) = \begin{cases} 0 & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ \texttt{maxval} & \text{otherwise} \end{cases}$
THRESH_TRUNC	$\texttt{dst}(x,y) = \begin{cases} \texttt{threshold} & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ \texttt{src}(x,y) & \text{otherwise} \end{cases}$
THRESH_TOZERO	$\texttt{dst}(x,y) = \begin{cases} \texttt{src}(x,y) & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ 0 & \text{otherwise} \end{cases}$
THRESH_TOZERO_INV	$\texttt{dst}(x,y) = \begin{cases} 0 & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ \texttt{src}(x,y) & \text{otherwise} \end{cases}$

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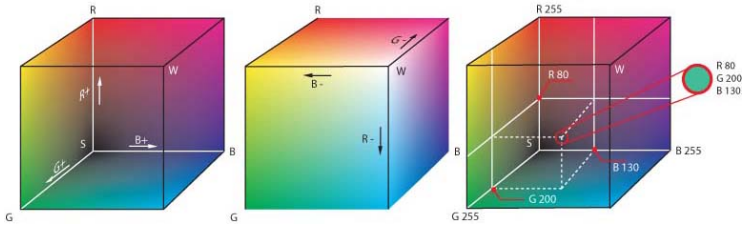
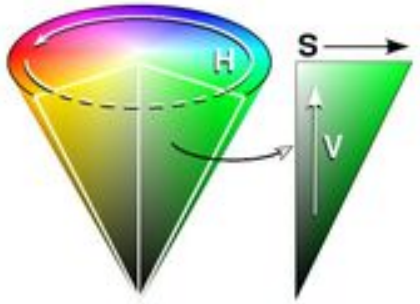
Image representation

- Color image: different models for different applications
  - B/W: Grayscale
  - RGB-model: specific for screens (Phosphor-crystals), very common
  - CMYK-model: Color printer (subtractive color mix)
  - YCbCr: Breakdown into luminescence Y und two color components Cb, Cr
  - HSV (Hue, Saturation, Value): specific for color segmentation



RGB

CMYK



HSV

Quelle: Wikipedia

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Regiongrowing

- Connected regions regarding $H(f_v)$
- Based on seeds
  - Manually defined from the user
  - Seeds are in a region
  - $H(f_v)$ can be defined through the neighbors of the seeds
  - Depending on the criteria the results depends on the positon of the seeds

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Regiongrowing

Workflow

- Define seed as starting value
- Consider neighbors (not seen before)
  - Mark pixel as seen
- If pixel fulfills criteria H
  - Yes: Use this pixel as new seed point
  - No: End

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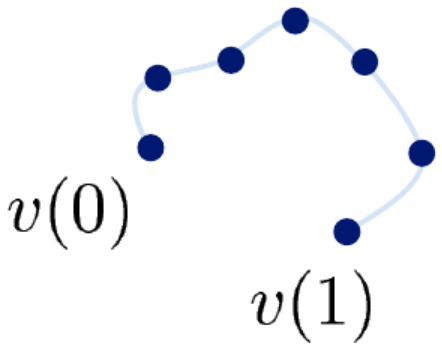
Active Contours

- Definition:
  - Representation of a curve through n points

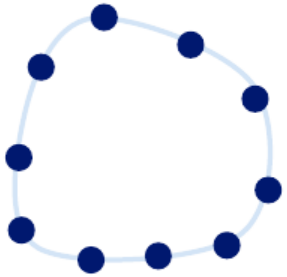
$$v : [0, 1] \rightarrow \mathcal{R}^2$$

$$v(s) = \begin{pmatrix} x(s) \\ y(s) \end{pmatrix}$$



- Closed Curve

$$v(0) = v(1)$$



Active Contours

- Energy minimization problem

$$E = \int_0^1 (E_{int}(v(s)) + E_{image}(v(s))ds$$

Internal Energy

Describes the form of a curve

External Energy

Adaption to the edge

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Are there any questions ?