Seminar Zellbildanalyse

Vorbereitungstreffen 20.Oktober 2011

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Motivation

COSIR

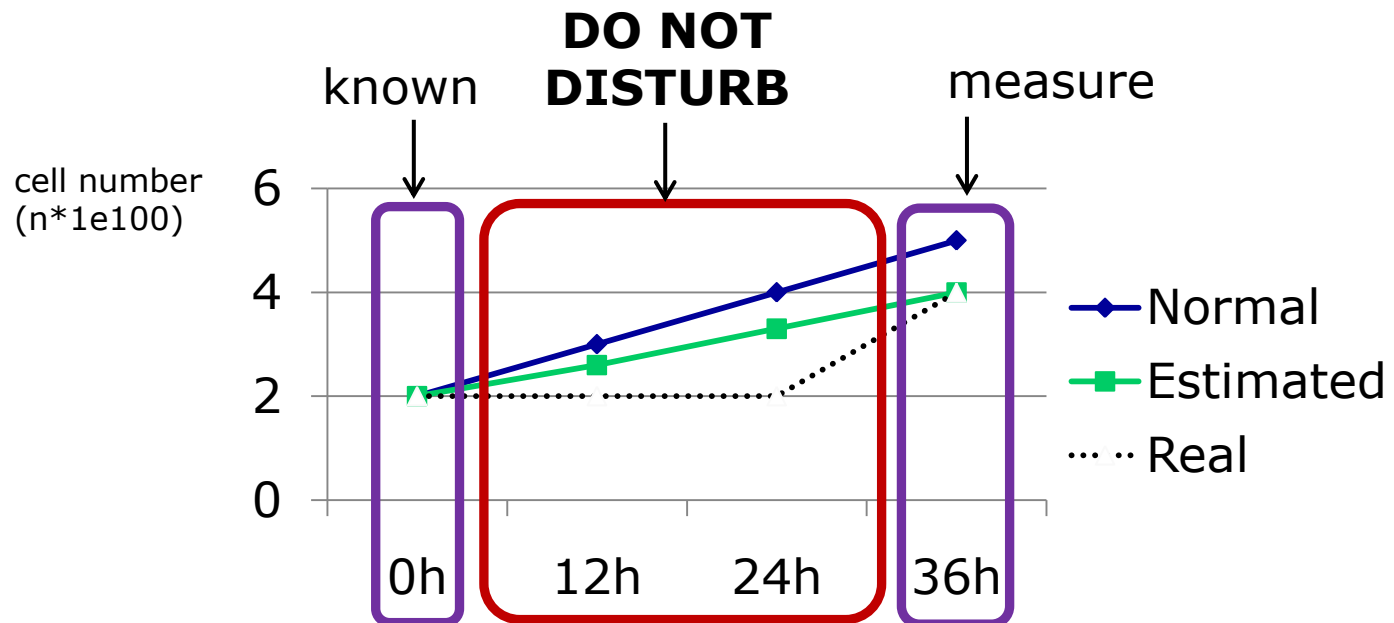**C**hemical and **O**ptical **S**ensors and **I**mage **R**ecognition

Aim: Real-time observation/analysis of cell cultures

Why?

Motivation – The system

- **Miniature microscope**
- **CCD sensor**
- **One/several LEDs for scene illumination**
- **LEDs on same side as CCD sensor → reflectance microscopy**

→ Output are images of reduced quality

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Topics

Enhancement → **Segmentation** → **Classification**

- Typical artifacts: noise, bias fields, low contrast….

- Decide for each pixel: (same) object or background
- Different strategies: pixel-based, model-based, region-based…

- Extract typical features from pixel or object
- Based on those features, decide to which class this pixel or object belongs

T: Microscopy techniques

- Thorough explanation of different microscopy techniques:
    - brightfield
    - darkfield
    - confocal
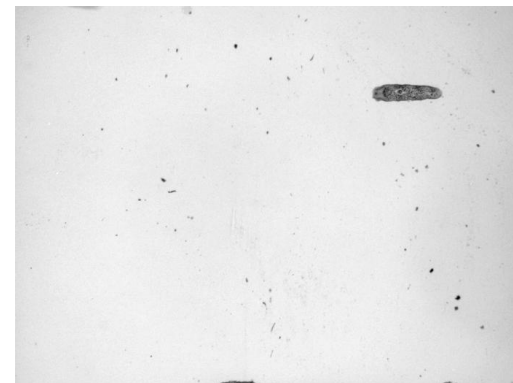   - fluorescence
    - electron
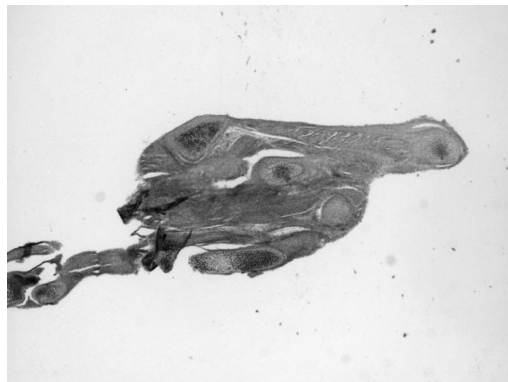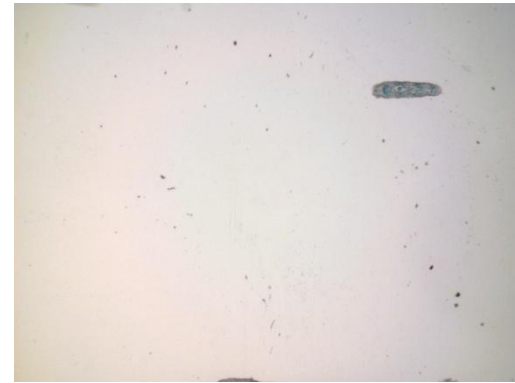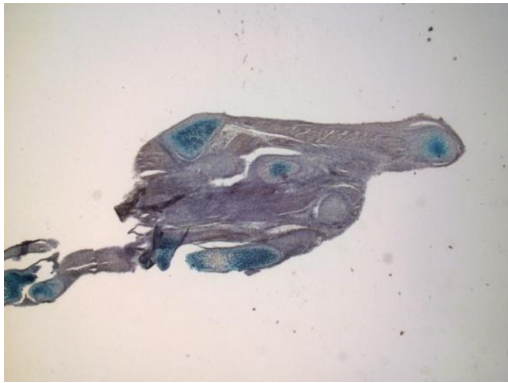   - phase contrast
    - …

- No programming part!
- Extended, thorough high-content 1 h talk though…

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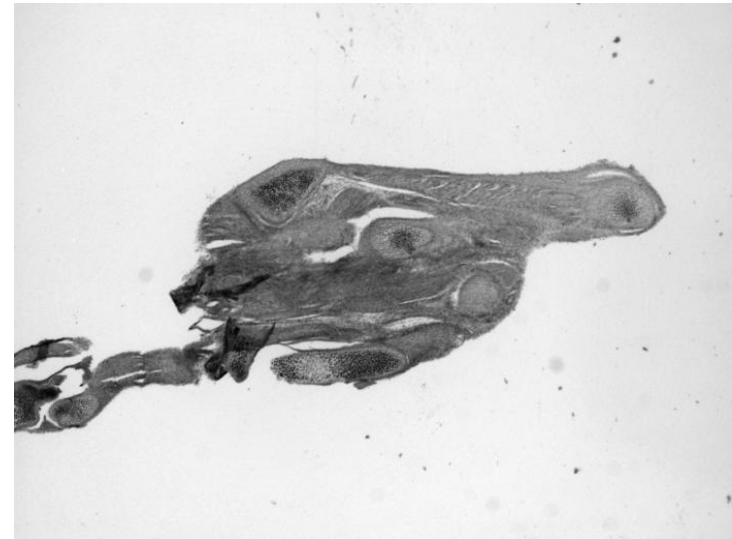
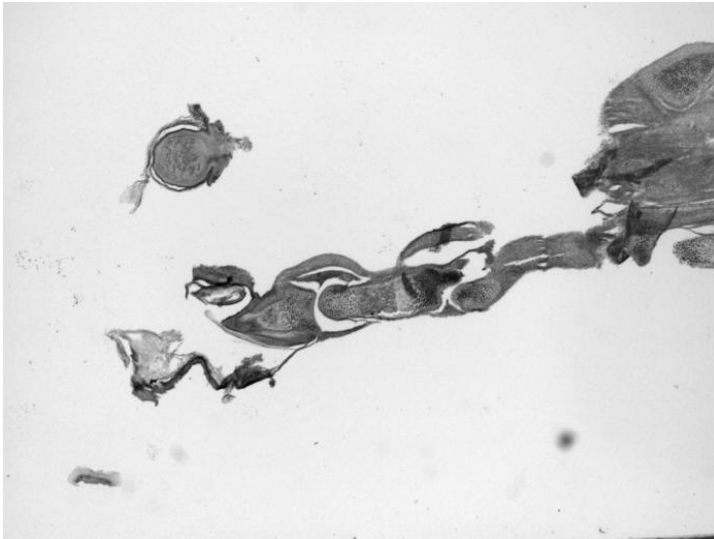# T: Illumination correction

- Correction of inhomogeneous light fields

T: Image Blending

- Blending strategies for overlapping images
- typical example: panorama images

- Add? Linear interpolation? Frequency-based?
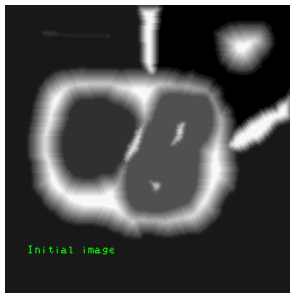
T: Superresolution

- Superresolution:

Improve image resolution by combination of different images showing the same scene

- Possible to use image sequences/motion? (one topic)

- Single-image superresolution (another topic)

T: Watershed segmentation

- Based on intensities

- Dark colors = valleys, bright colors = hills

- Basic idea:
  Start from seedpoints, "flood" image with water
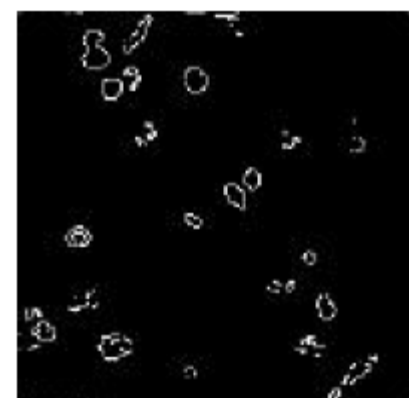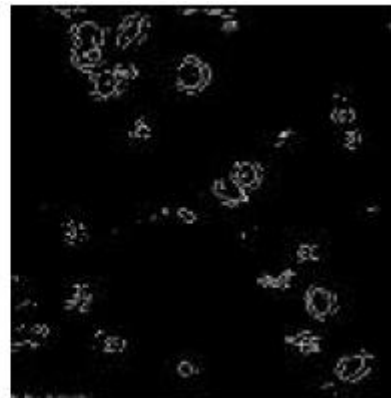
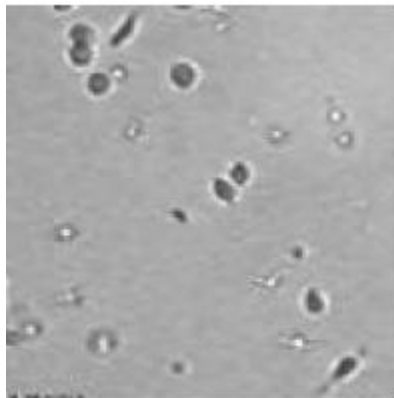- Other approaches available

Initial image

Topographic surface

Building the dam ...

- Problems: Often over-segmentation

(c) http://cmm.ensmp.fr/~beucher/wtshed.html

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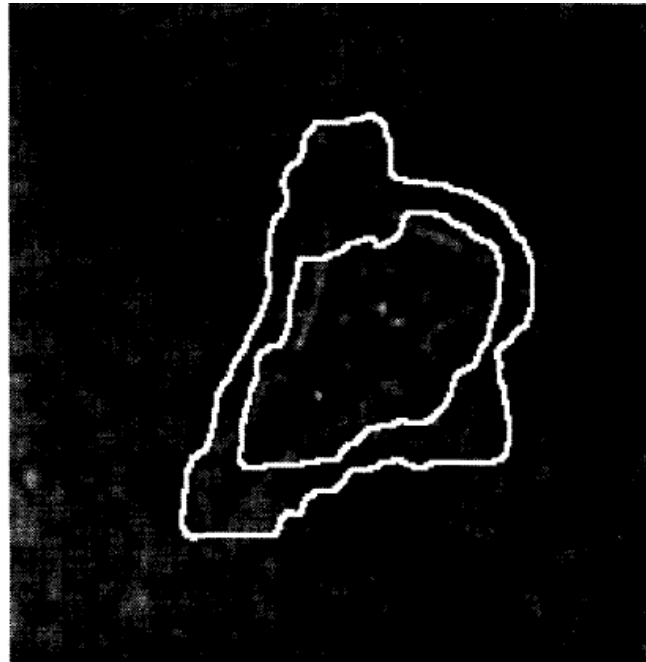
T: Compare: simple standard methods

- Many simple segmentation methods using thresholds, morphology operators, …

- How do these basic methods behave?

- Intelligent combination possible?
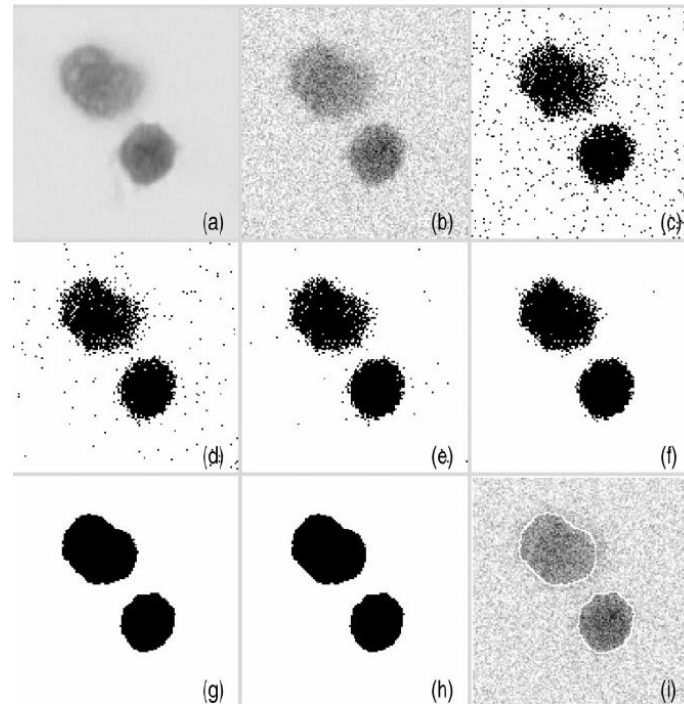
T: Segmentation using the variance map

- Intensity might be less discriminative than the local variance!

- How do different thresholding techniques work applied on local variance?
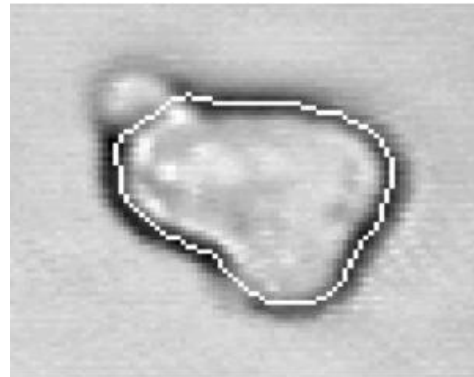
T: Iterative Thresholding Segmentation

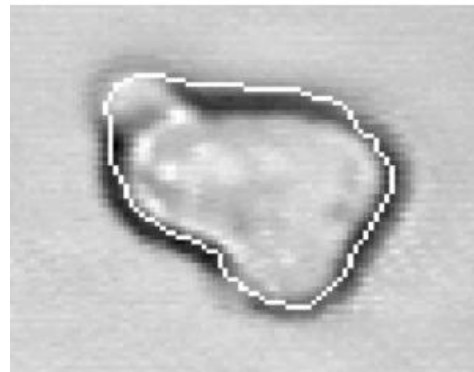- Iteratively refine initial segmentation based on local image activity

T: Level Set Segmentation

- Model cell boundary by parametric curve
- Evolve/change curve over time to fit to boundary

(a)

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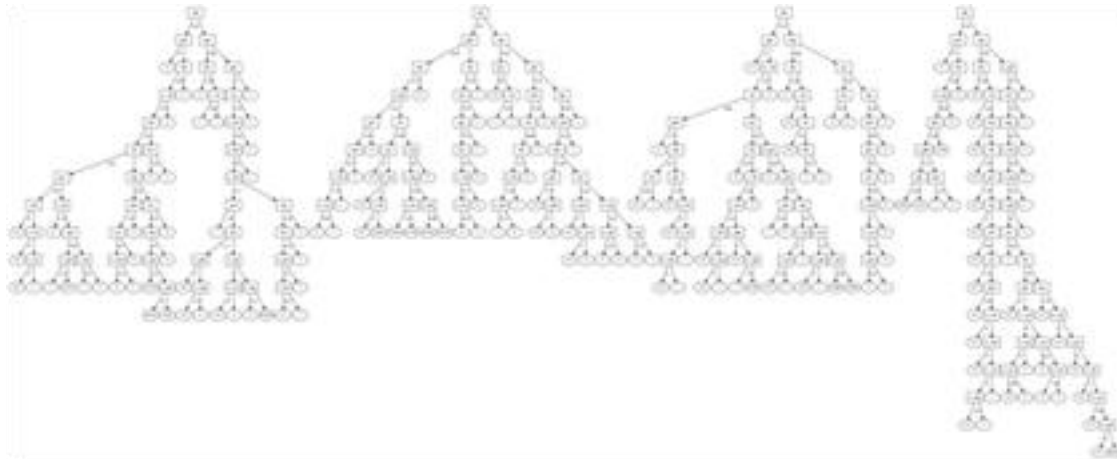
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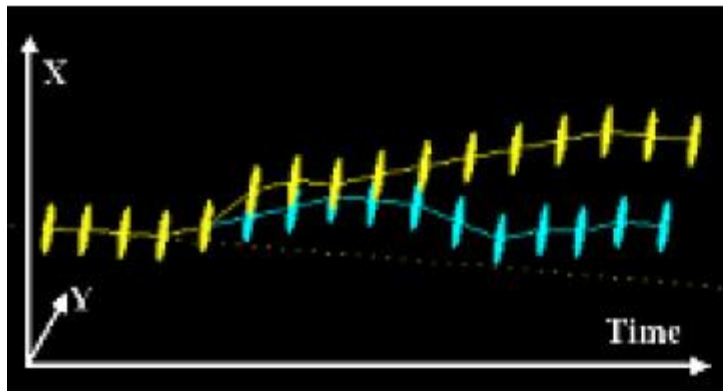
T: Segmentation with forests

- Use simple decision trees
- Combine many decision trees to a forest
- Put feature vector into forest
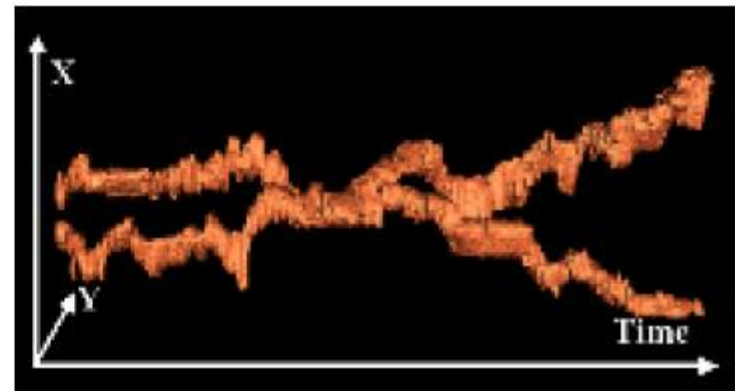- forest decides: cell or background

T: Cell Tracking

- Time information:
  Does a cell move? Where? When? General activity?

- Different tracking approaches:
  non-rigid registration, SIFT features, KLT
  tracker, model of movement…

(a)

T: Your topic

- Are you interested in a certain approach that is not listed?

- Make a suggestion!

Topic selection

- Presentation will be online on seminar website

- Look at the topics, research the methods

- Choose several that you're interested in

- Note: Several topics HAVE to be taken
  (e.g. the different microscopy techniques)
  List of those topics will be online monday/tuesday

- Meeting next week:
  Distribution of topics

- If several people are interested, the qualification or a dice will decide

Organization

Prerequisites (ideally, not mandatory)

- Lectures in Pattern Recognition/Analysis

- Established programming skills (C++/Matlab/OpenCV/ITK)

What you can get

- 5 ECTS credits

When & Where

- Thursdays (next year), 10-12, 09.150

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Your tasks

Provided:

- One or several articles for your topic
- Image data

Your task:

- Understand the theory of your particular method
- Implement the approach and evaluate it
- Prepare a talk covering theory and practice
- Give the talk and present your practical results

Disclaimer

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