



ISAAK

## Classifying vessel shapes

using automated shape extraction and unsupervised classification

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## Motivation

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## **Vessel shape and typology**

## **Available Approaches**

## Using specific locations

- Koch 1998

## 'Hollistic' approaches

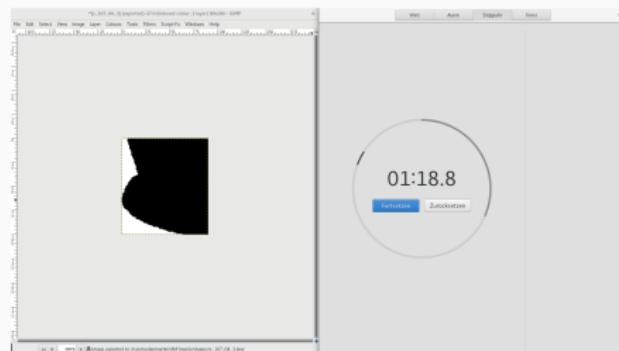
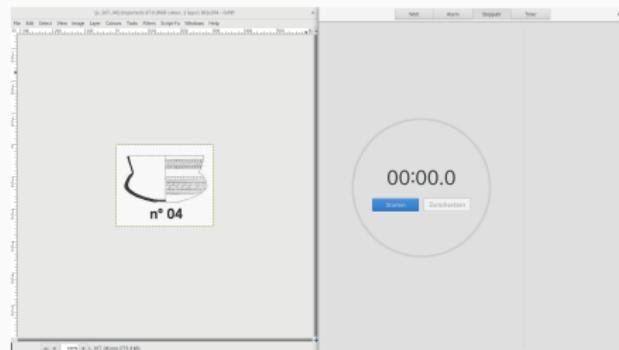
- Mom 2005
- Chapman et al., 2006
- Keogh et al., 2009

## Shape Extraction

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**'by hand'**

# Workflow



## **Adaptive Contour**

## Problem

- Scanned vessel drawings might have holes (dashed lines)
- No simple image segmentation with background color and floodfill possible

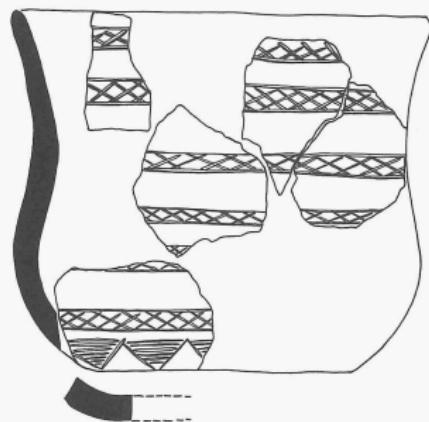


Figure 1: Bell Beaker (Harrison 1977)

## Solution: Active contour

**Active contour model**, also called *snakes*, is a framework in computer vision for delineating an object outline from a possibly noisy 2D image. The snakes model is popular in computer vision, and snakes are greatly used in applications like object tracking, **shape recognition**, segmentation, edge detection and stereo matching. Wikipedia

source: <https://github.com/pmneila/morphsnakes>

# Active contour with Beakers

See shapAAR vignette

<https://github.com/ISAAKiel/shapAAR/blob/master/vignettes/object-extraction.md>

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	Image preparation	bw, blur
	Image segmentation	active_contour
	Selecting the biggest object	EBImage
	Rectify and crop	get Bounding box, rotate upright, crop
	half and side mean	split in middle, mean left-right

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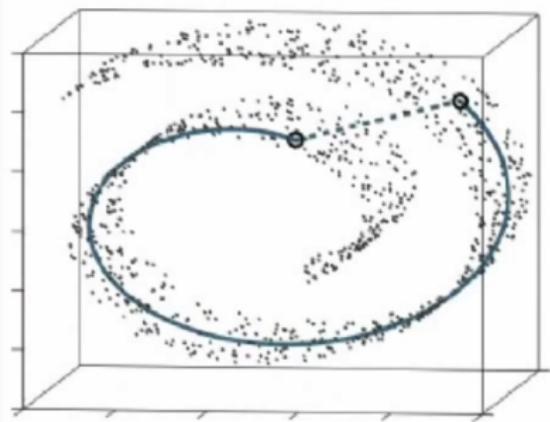
## **Shape Analysis**

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## **PCA & hclust**

**t-sne & hdbSCAN**

## t-Distributed Stochastic Neighbor Embedding

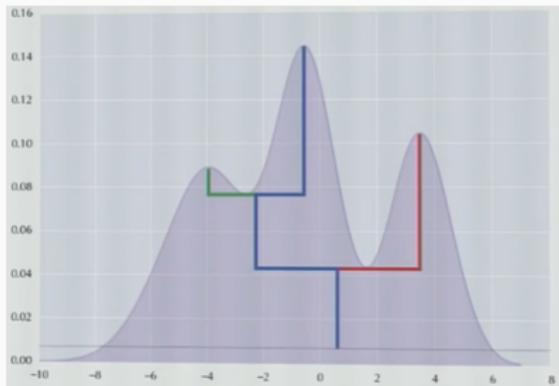


### Challenge

- high dimensional non-linear data distribution
- consider not the global, but the local neighbourhood (contrasting PCA)

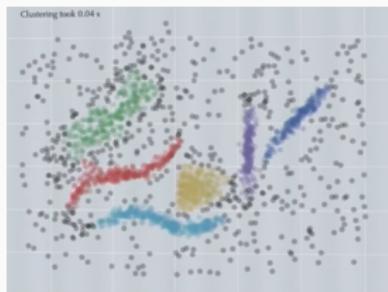
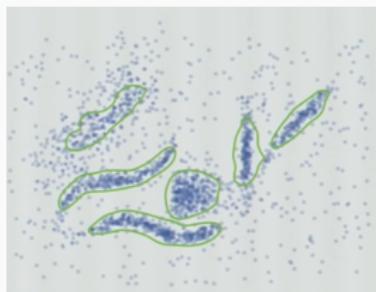
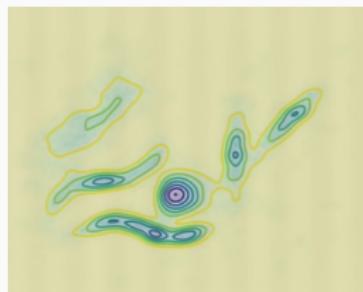
Figure 2: van der Maaten 2008; 2009; 2012; 2014;  
<https://lvdmaaten.github.io/tsne/>  
<https://www.youtube.com/watch?v=RJVL80Gg3IA>

## Hierarchical Density-Based Spatial Clustering of Applications with Noise



### Benefits:

- separating non-circular clusters
- 'identification' and exclusion of noise (hand made ceramics!)



## **Case studies**

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## **Bell Beakers of the Iberian Peninsula**

## **Neolithic Swiss Ceramic**

# Thank you



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