Classifying vessel shapes

using automated shape extraction and unsupervised classification

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Motivation

Vessel shape and typology

Available Approaches

Using specific locations

- Koch 1998

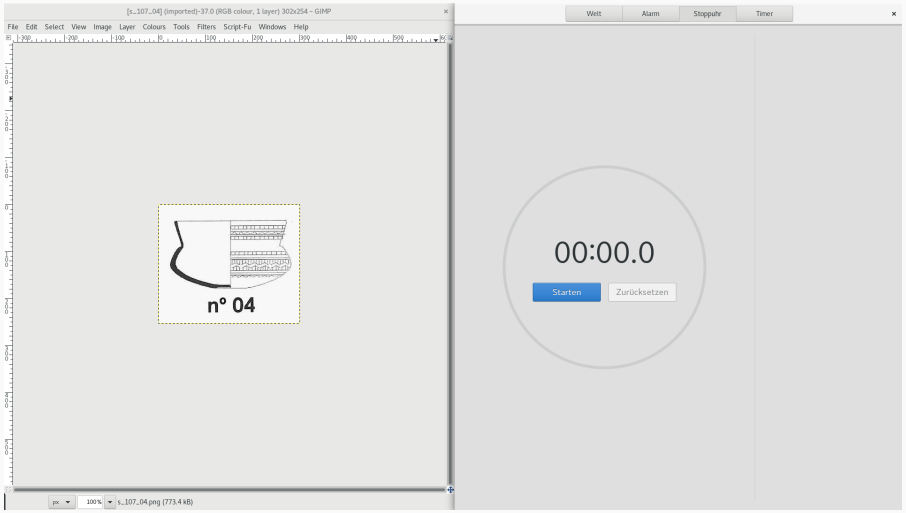
‘Hollistic’ approaches

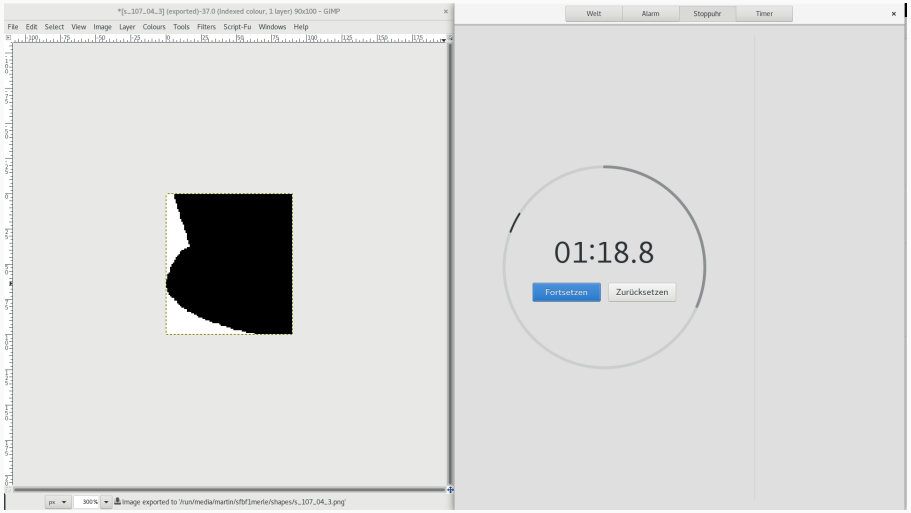
- Mom 2005
- Chapman et al., 2006
- Keogh et al., 2009

Shape Extraction

‘by hand’

Workflow


Welt
Alarm
Stoppuhr
Timer
n° 04
00:00.0
Starten
Zurücksetzen


Welt
Alarm
Stoppuhr
Timer
01:18.8
Fortsetzen
Zurücksetzen

Adaptive Contour

Problem

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

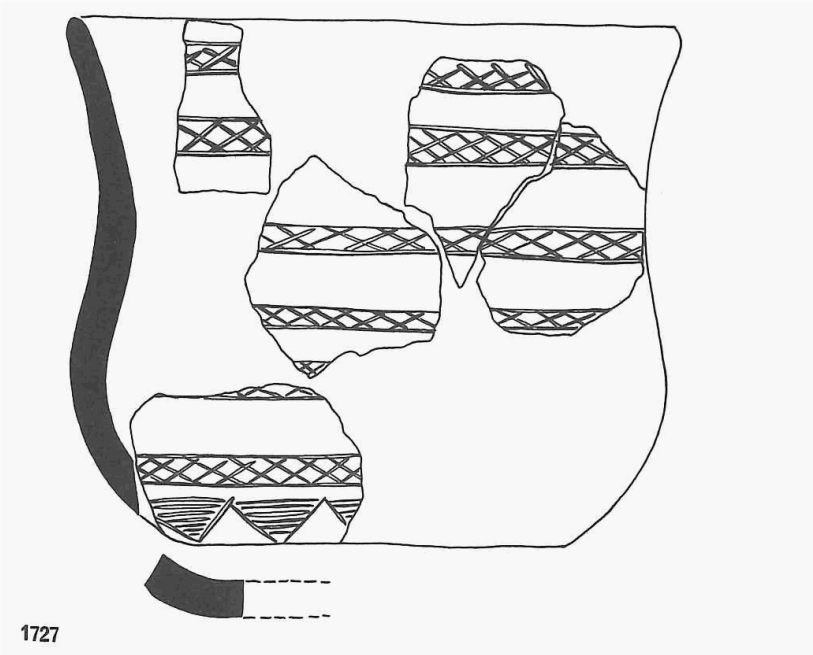


Figure 1: Bell Beaker (Harrison 1977)

Solution: Active contour

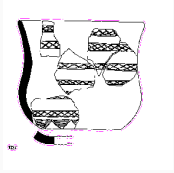
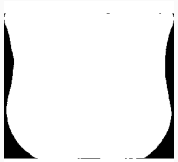
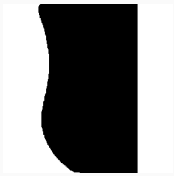
Active contour model, *also called* ***snakes***, *is a framework in computer vision for delineating an object outline from a possibly noisy 2D image. The snakes model is popular in computer vision, and snakes are greatly used in applications like object tracking,* ***shape recognition***, *segmentation,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

	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

Shape Analysis

PCA & hclust

t-sne & hdbscan

t-Distributed Stochastic Neighbor Embedding

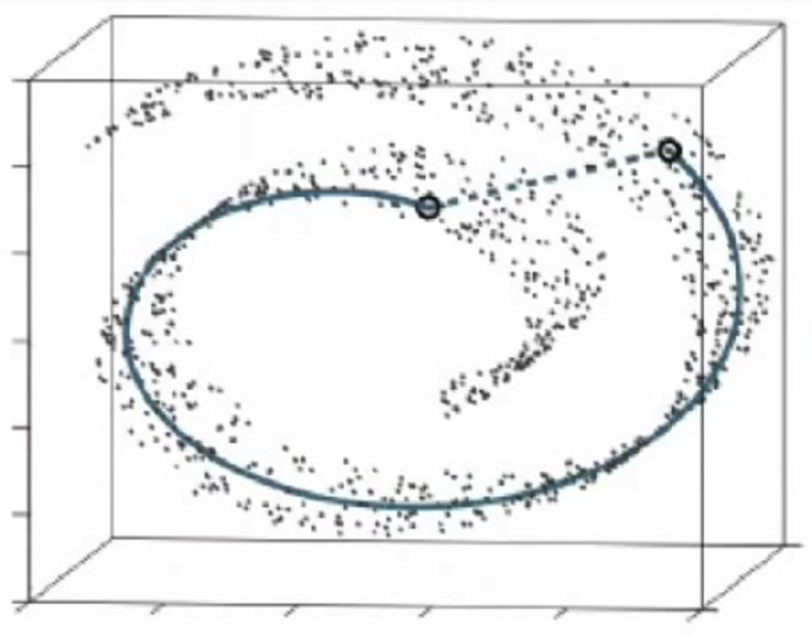


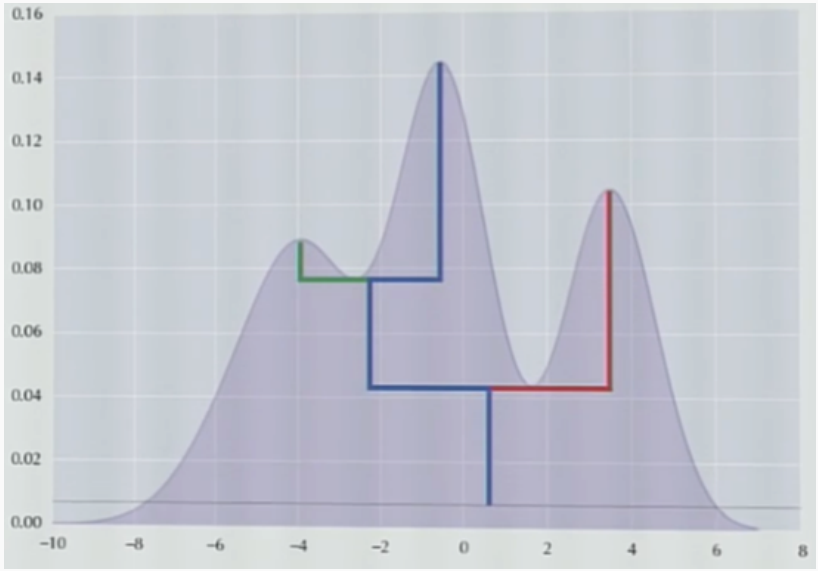
Figure 2: van der Maaten 2008; 2009; 2012; 2014;
https://lvdmaaten.github.io/tsne/
https://www.youtube.com/watch?v=RJVL80Gg3lA

Challenge

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

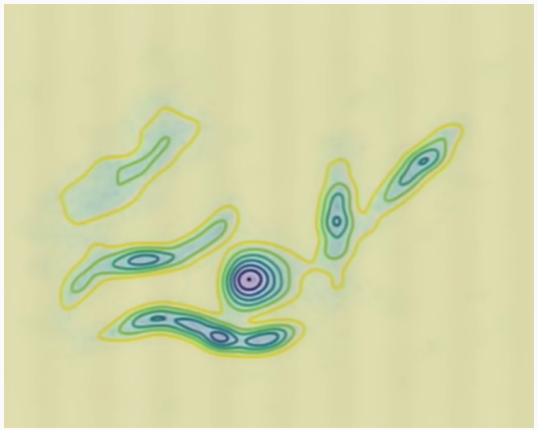
hdbscan

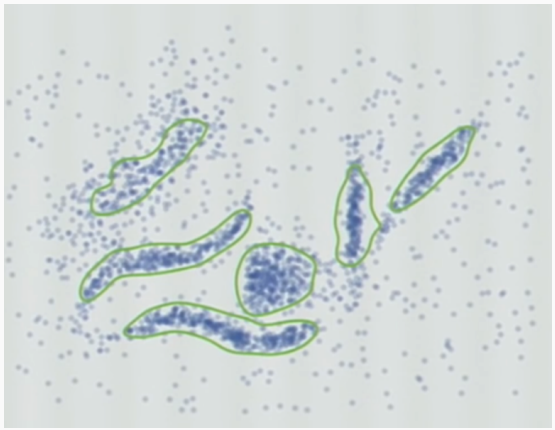
Hierarchical Density-Based Spatial Clustering of Applications with Noise

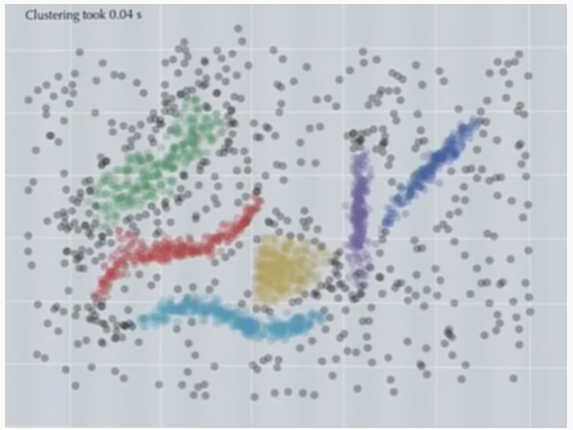


Benefits:

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







Case studies

Bell Beakers of the Iberian Peninsula

Neolithic Swiss Ceramic

Thank you