Signal Processing LABORATORY

www.splab.cz

3rd SPLab Workshop 2013

Segmentation of Sedimentary Grain in Electron Microscopy Image

Aleš Křupka

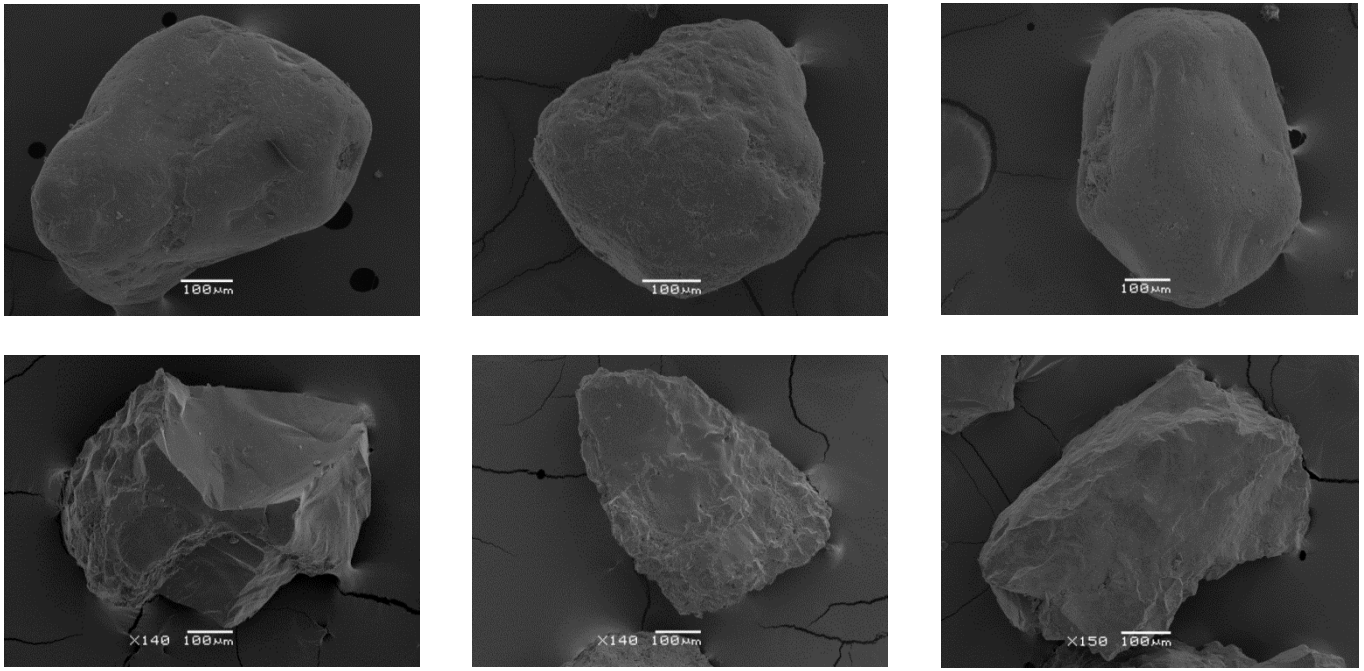
akrupka@phd.feec.vutbr.cz

Department of Telecommunications
Faculty of Electrotechnical Engineering and Communication
Brno University of Technology

evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Sedimentary grain processing

- Grains represent a given geological area
- Analysis of grain properties for making statements about the area
- Motivation for development of automated methods
  - to ease the process of analysis of grain properties



Sedimentary grain processing

Content of the presentation

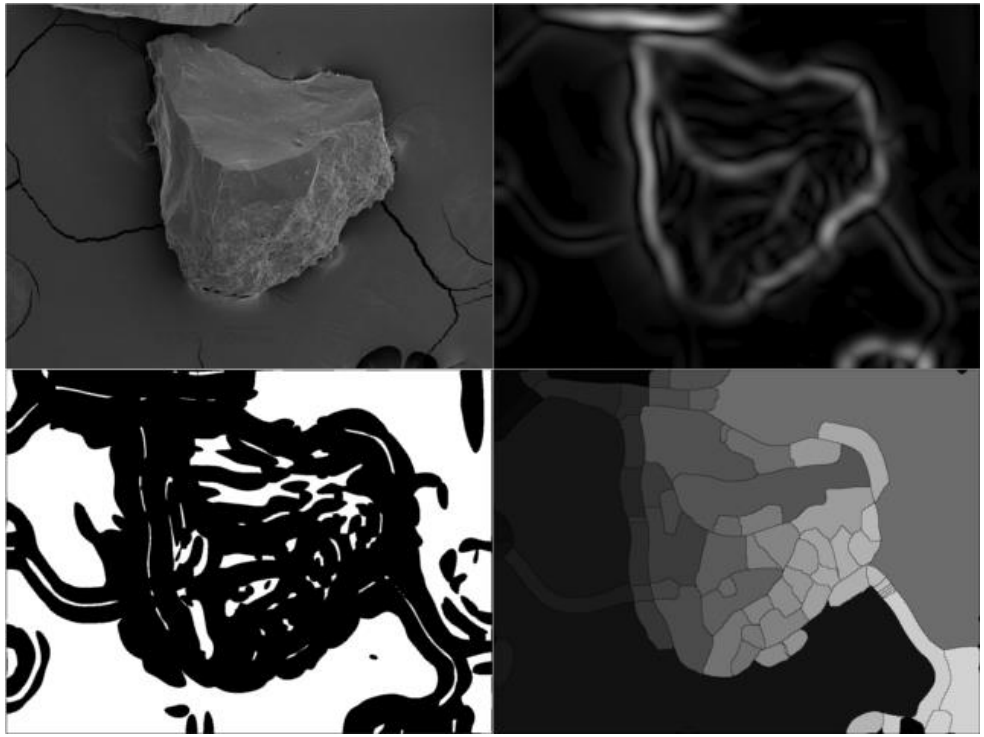
- Developed segmentation method
- Initial work on extraction of surface characteristics of grains

Segmentation

- Split and merge principle

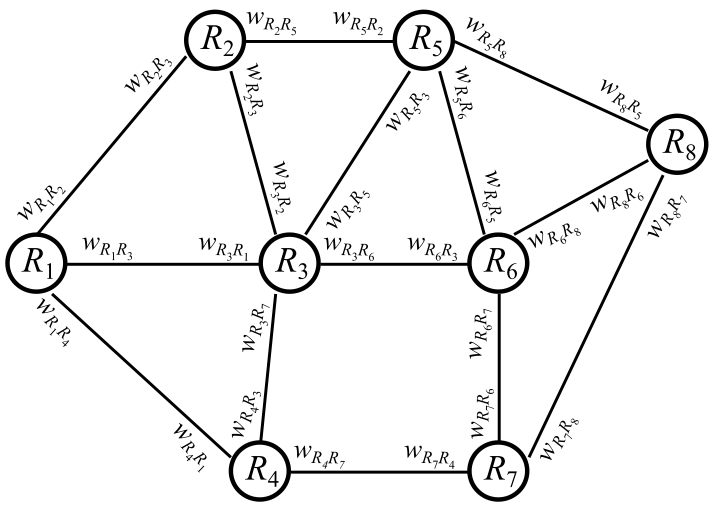
Segmentation - split

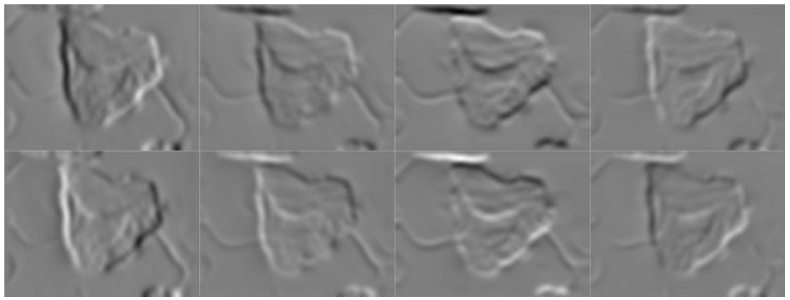
- Marker-controlled watershed segmentation



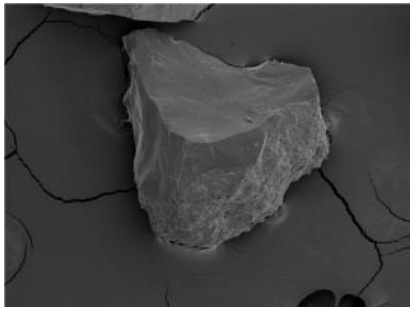
Segmentation - merge

- Graph – represents relations between adjacent regions





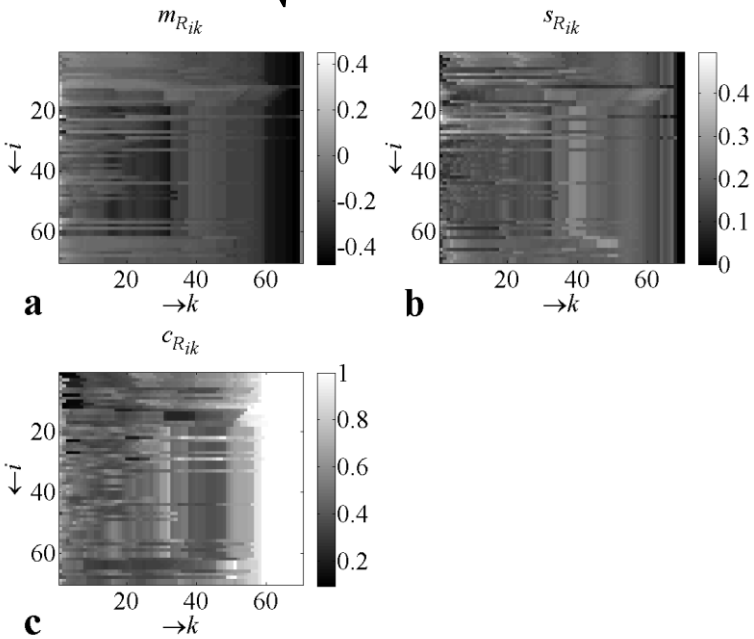
α ϵ {0, 45, 90, 135, 180, 225, 270, 315}°



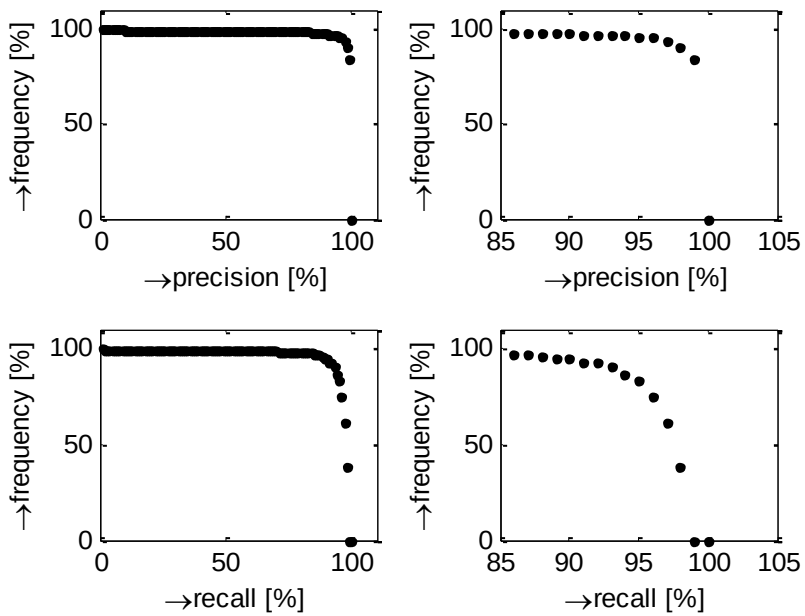
- $w_{R_iR_j} = \sum_{p=1}^{N_{R_iR_j}} grd_{b_{R_iR_j}(p)}(a_{R_iR_j}(p)) / N_{R_iR_j}$

Segmentation – merge

- Measures for region sets evaluation
- $m_{R_{ik}} = \sum_{R_j \in V_{ik}} w_{R_{ik}R_j} N_{R_{ik}R_j} / \sum_{R_j \in V_{ik}} N_{R_{ik}R_j}$
- $s_{R_{ik}} = \underset{R_j \in V_{ik}}{\text{stddev}}\, w_{R_{ik}R_j}$
- $c_{R_{ik}} = 2\sqrt{\pi \sum_{R_j \epsilon R_{ik}} F_{R_j}} / \sum_{R_j \epsilon V_{ik}} N_{R_{ik}R_j}$



Segmentation - results



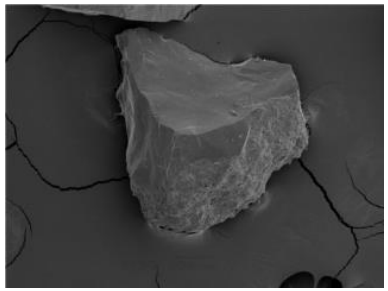
Prec. [%]	Freq. [%]	Recall [%]	Freq [%]
100	0,0	100	0,0
98	90,6	98	38,5
95	96,2	95	86,8
93	97,1	93	90,6
92	97,1	92	92,6
90	97,6	90	95,0
85	98,2	85	97,4
80	98,8	80	97,9

- Precision = $TP/(TP + FP)$
- Recall = $TP/(TP + FN)$

- Křupka, A., Říha, K., Křížová, L., Segmentation of Sedimentary Grain in Electron Microscopy Image, *Radioengineering*, vol. 22, no. 3, 2013, pp. 883-891.

Analysis of grain properties

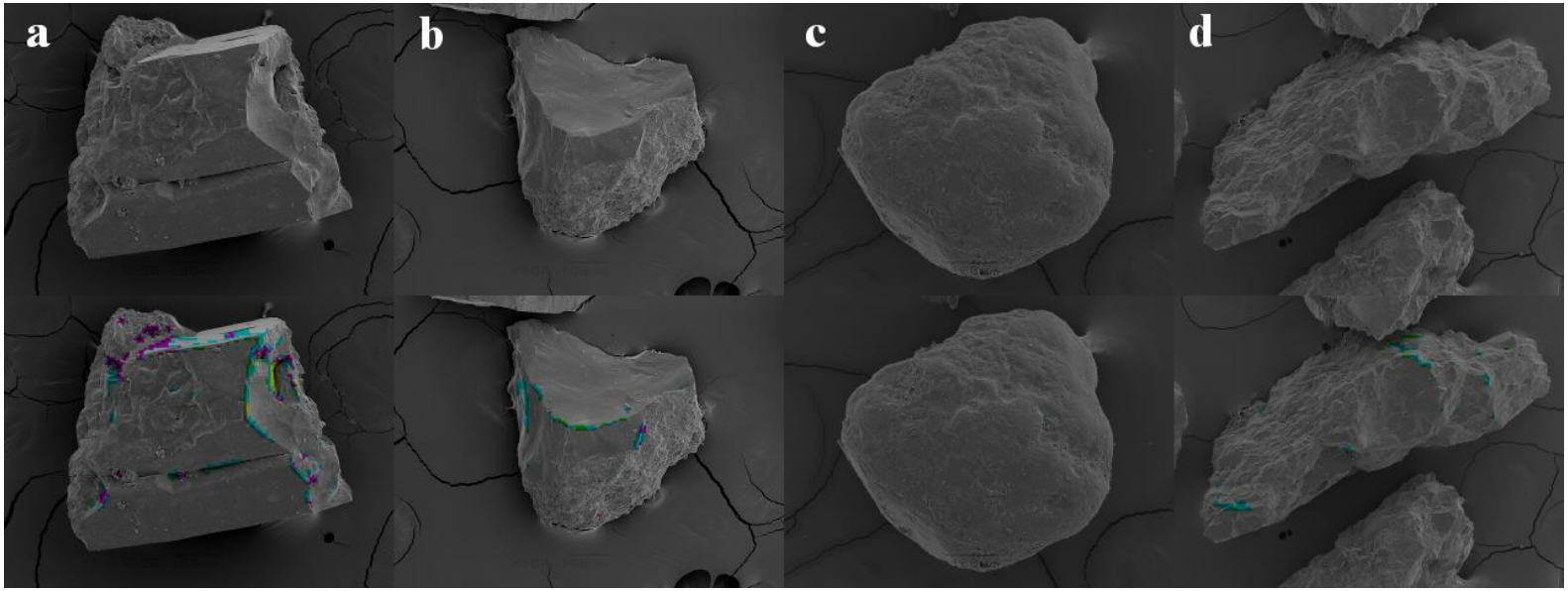
- To qualitatively evaluate possibilities of texture features – co-occurrence features
- Using *K*-means clustering
- No ground-truth
- Examined visually
  - If some surface characteristics can be discriminated by using co-occurence features



- Křupka, A., Definition of Typical Textures of Sedimentary Grains Using Co-occurrence Features And K-means Clustering Technique, *The International Journal of Advances in Telecommunications, Electrotechnics*, Signals and Systems, vol. 2, no. 2, 2012, pp. 68-72.

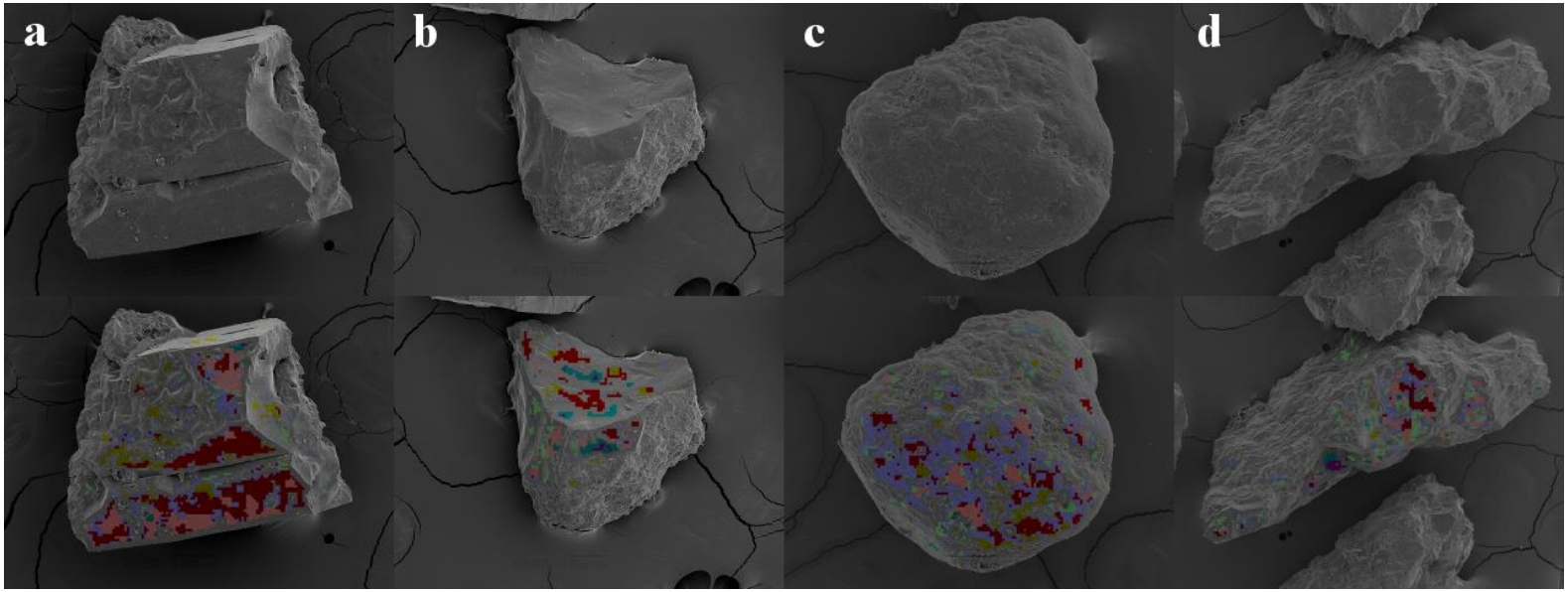
Clustering results

- Corners



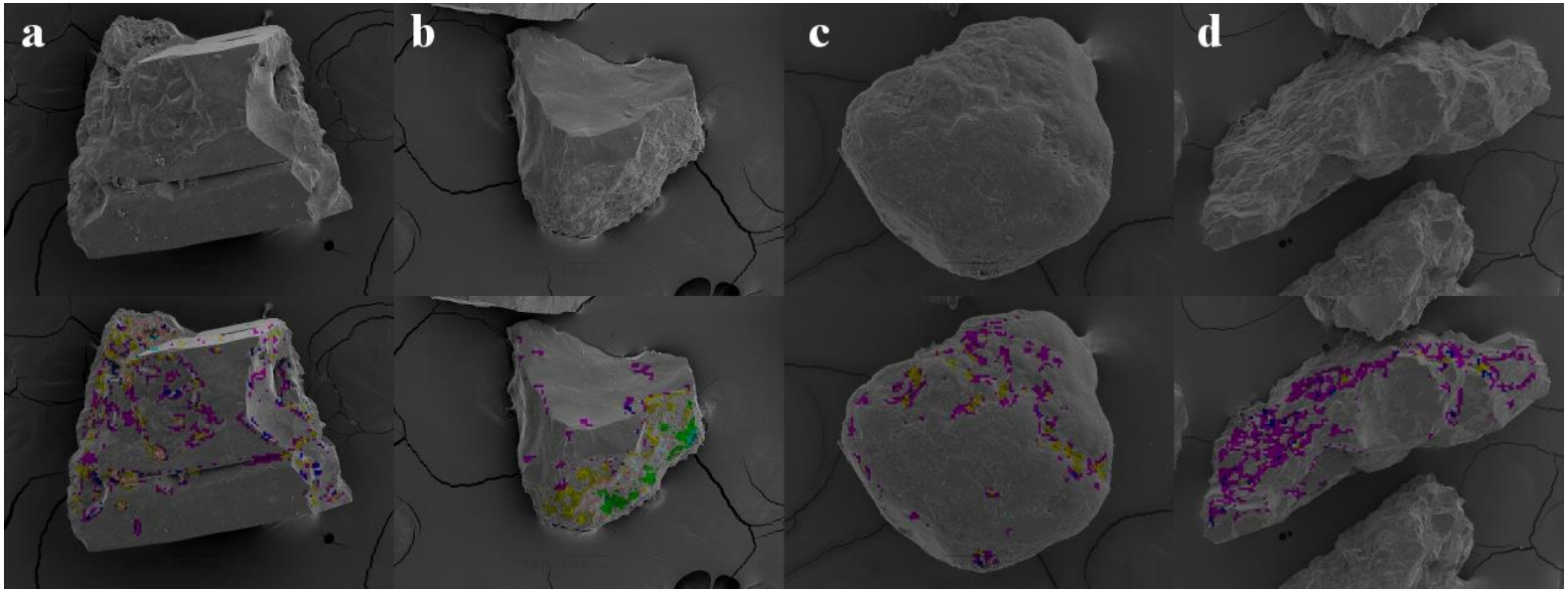
Clustering results

- Homogeneous parts



Clustering results

- Rough surface



Conclusion, future work

- Segmentation
  - Method with relatively small number of false positive pixels
- Analysis of surface
  - Clustering – disadvantages
    - no numerical evaluation of results
    - no feature selection
  - Thus, labeled database will be prepared
    - use of supervised machine-learning methods
    - feature selection

Signal Processing LABORATORY

www.splab.cz

Thank you for attention!

Aleš Křupka akrupka@phd.feec.vutbr.cz

evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ