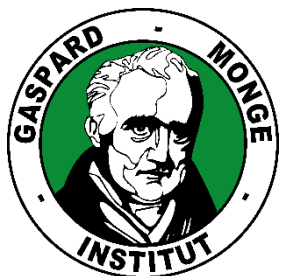


# Evaluation of morphological hierarchies for supervised segmentation

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28/05/2015



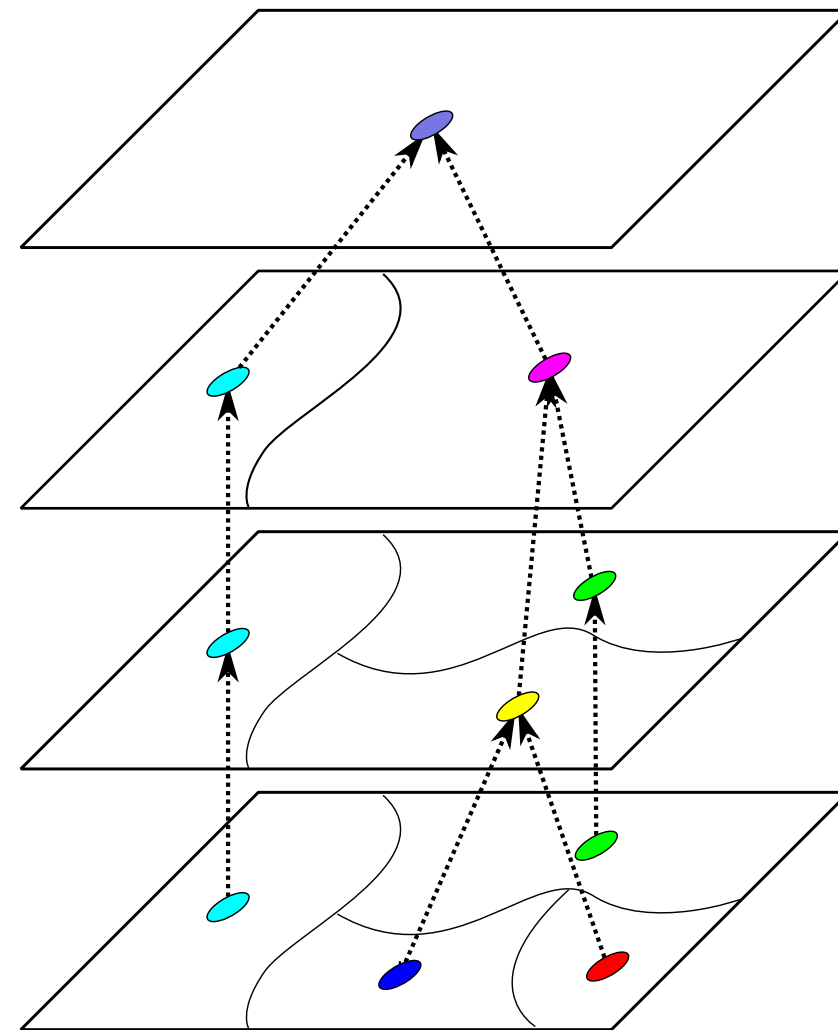
# Introduction

## Motivation

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- Several hierarchies of partitions
  - Quasi-flat zones (alpha-tree), watersheds, constrained connectivity...
- How do they compare to each other:
  - Noticeable differences in applications?
  - *Best* hierarchy(ies)?
- How to compare/evaluate hierarchies?
  - No hierarchical ground truth
  - Comparison to segmentation

Arbelaez et al. PAMI 11



# Introduction

## Proposed evaluation framework

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- One object image datasets
  - Grabcut and Weizmann datasets: 150 color images
  - One clearly identifiable object in each image
- Supervised segmentation
  - Background and foreground markers
  - Generated automatically from the ground truths
  - Simple strategy to extract a segmentation from a hierarchy and two markers



# Framework

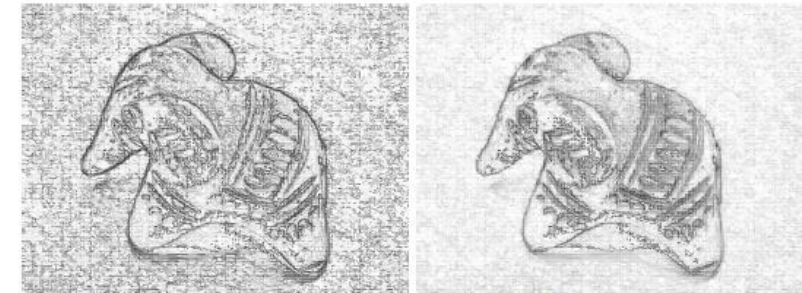
## Hierarchies

- **Quasi-flat zones** Nagao et al. 79, Meyer and Maragos 99
  - Minimum spanning tree, Single linkage clustering, Alpha-tree
  - Maximal dissimilarity between two adjacent pixels
- **Constraint connectivity** Soille PAMI 08
  - Chaining issue in the quasi-flat zones
  - Maximal dissimilarity between any two pixels of a component
- **Watershed** Beucher 94, Najman and Schmitt 96
  - Watersheds of an image flooded with an increasing sequence of closings
  - Closing attributes: altitude, dynamics, area, volume
- **Observation scale** Guimarães et al. 12
  - Based on Felzenswalb et al. segmentation algorithm
  - Combination between scale and contrast information



(a) Elefant from Grabcut DB

(b) Quasi-flat zones



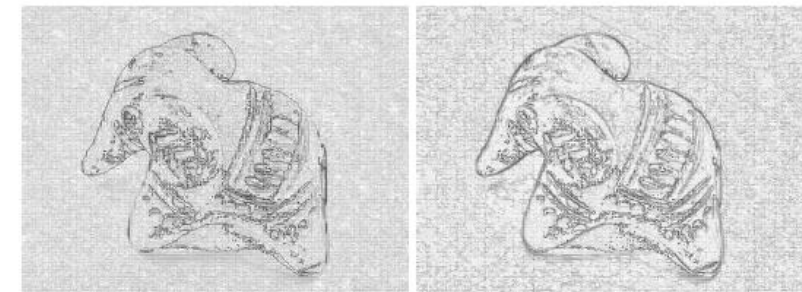
(c) Constrained connectivity

(d) Watershed Altitude



(e) Watershed Area

(f) Watershed Volume



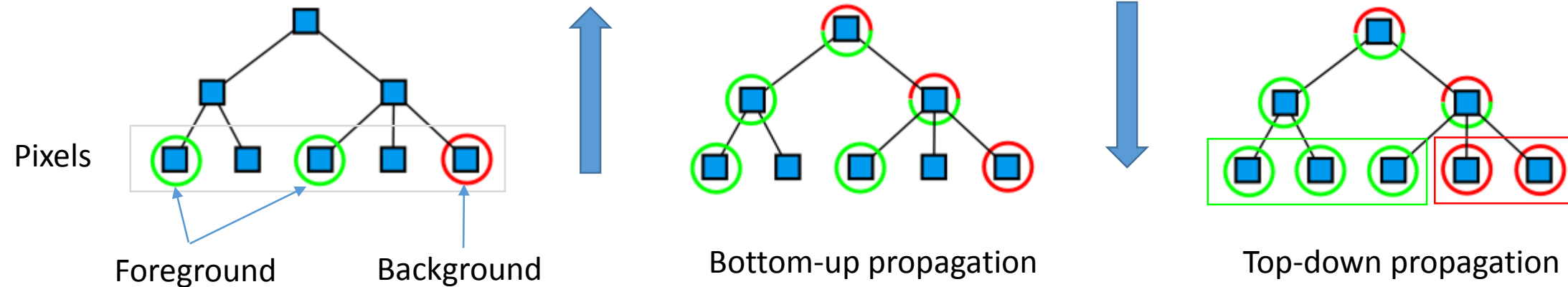
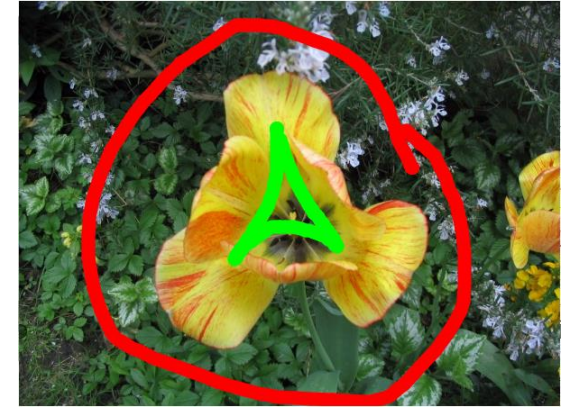
(g) Watershed Dynamics

(h) Observation scale

# Framework

## Segmentation extraction

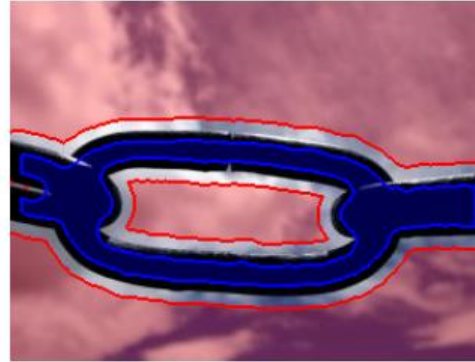
- Two markers
  - B: Background
  - F: Foreground
- Object :
  - the largest regions that intersect F but do not touch B



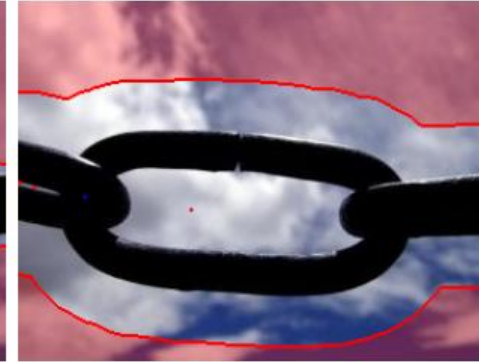
# Framework

## Automatic marker generation

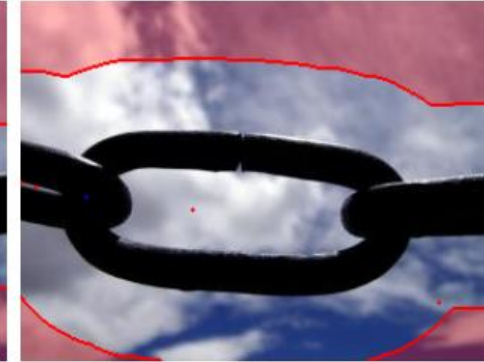
- Automatically extracted from the ground truths
- 5 markers:
  - High/Medium/Low Quality (HQ/MQ/LQ) : small/medium/large erosion
  - Skeleton (Sk)
  - Frame (Fr)
- 6 combinations



(a) HQ-HQ



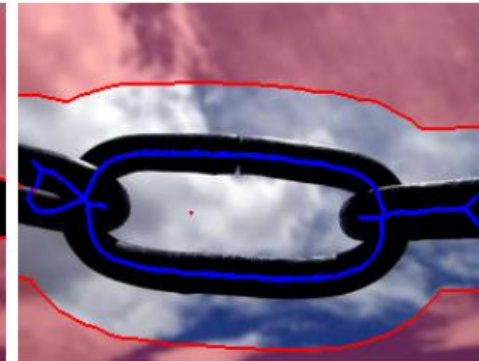
(b) MQ-MQ



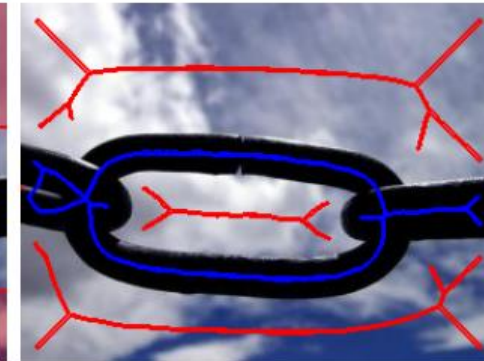
(c) LQ-LQ



(d) Sk-Fr



(e) Sk-MQ

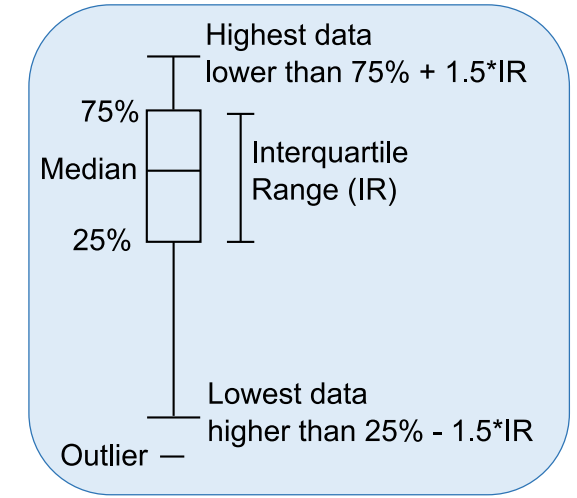


(f) Sk-Sk

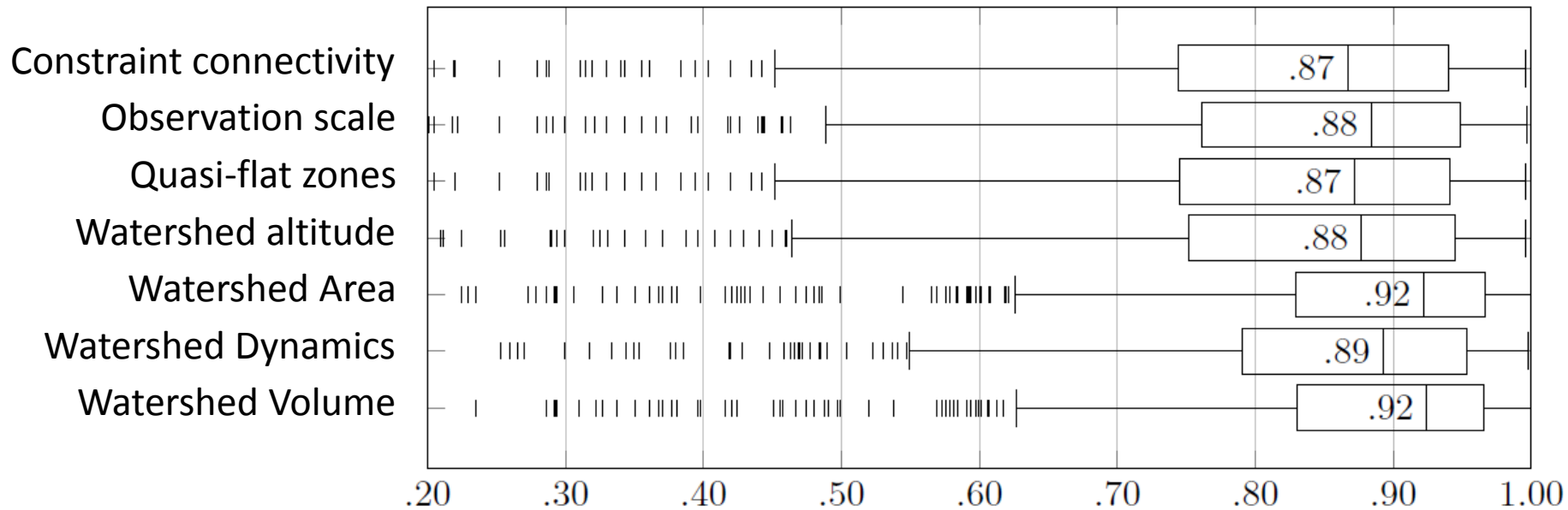
# Results

## Overall comparison

- Quality measure
  - F-measure
- 900 measures/hierarchy
- Parameters
  - Dissimilarity measure: Lab gradient
  - Adjacency: 4 neighbourhood



Box and whisker plot



- 2 groups
- CC, OS, QFZ, WS Altitude, WS Dynamics
  - WS Area and WS Volume on top

# Results

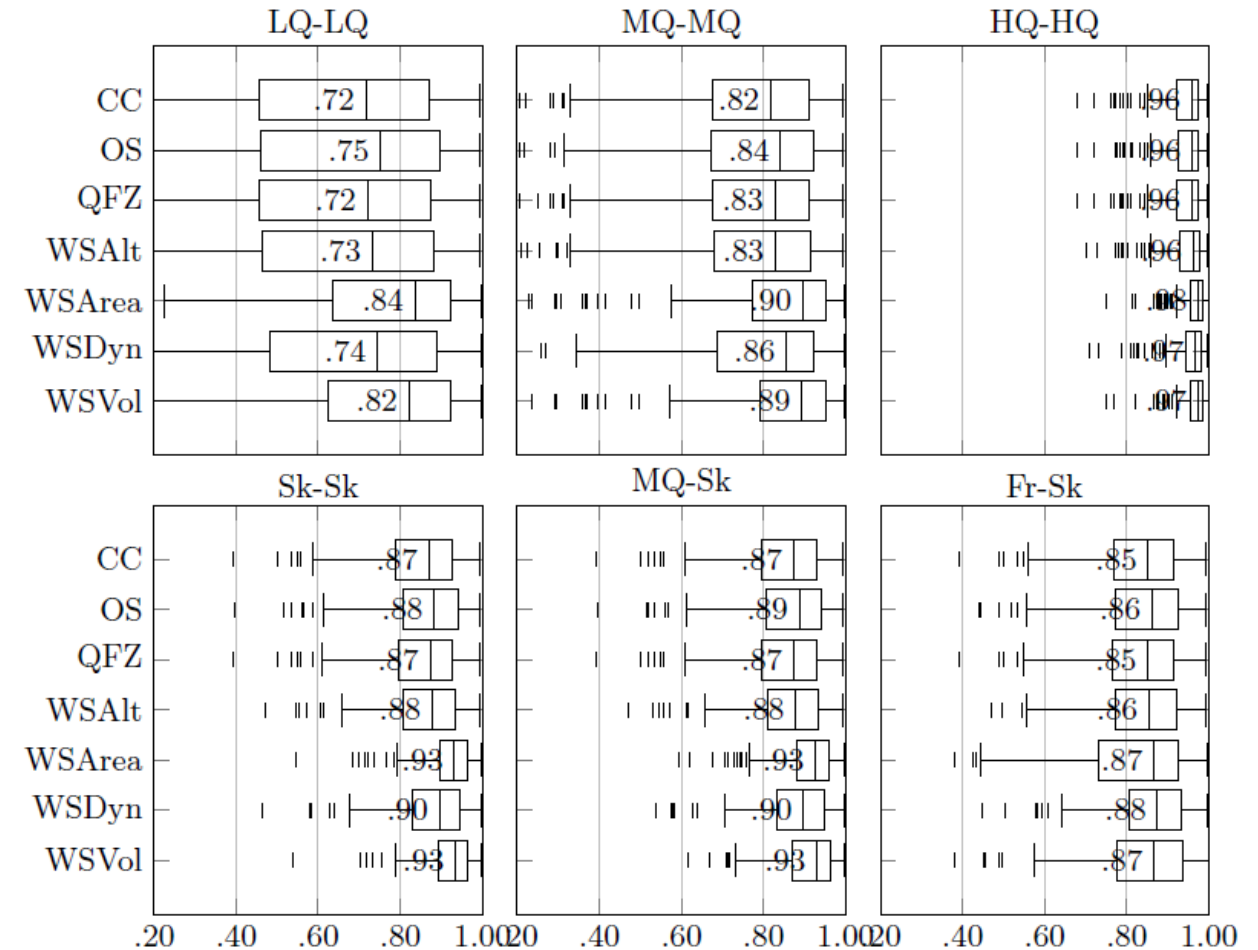
## Per marker combination

- First row

- Roughly symmetric markers
- WS Area seems a bit more robust than WS Vol

- Second row

- Asymmetric markers
- WS Area and Vol and much less robust
- All the other methods are quite insensitive to the variation of the background

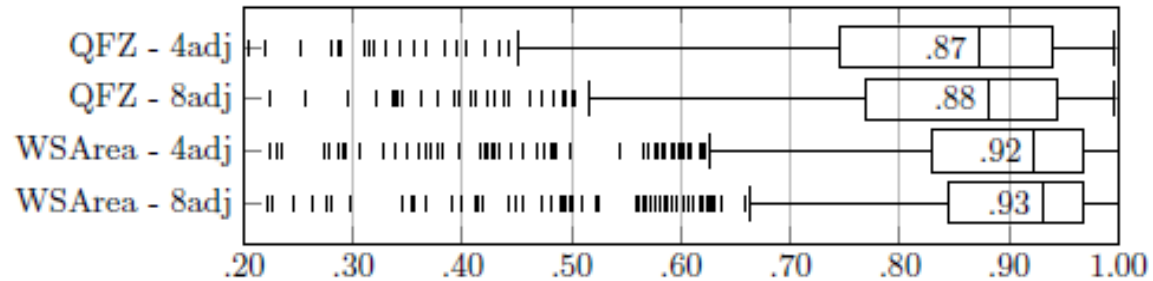




# Results

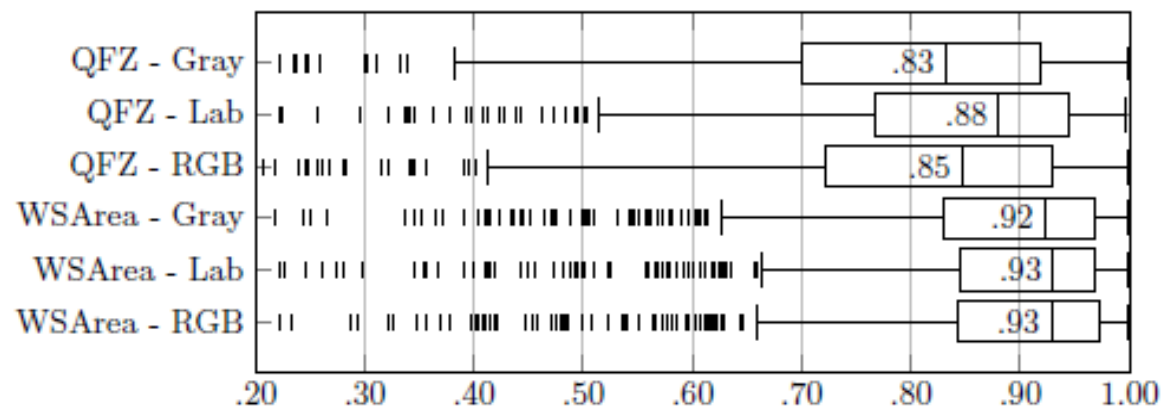
## Influence of parameters

- 4 or 8 neighborhood?



➤ Slight systematic improvement with 8 neighborhood

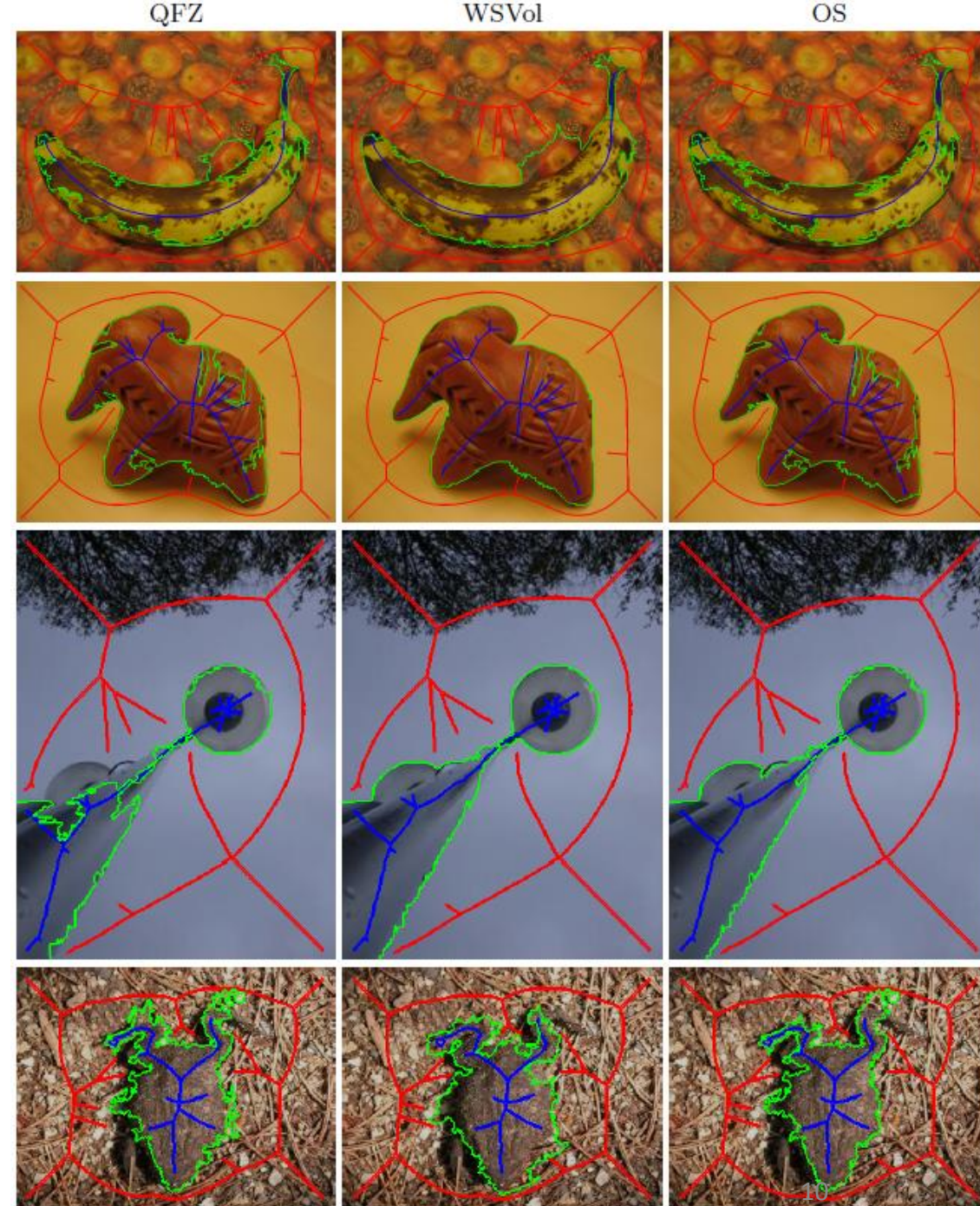
- Dissimilarity measures: gray, RGB, Lab?



➤ Confirmation of expected results: Lab > RGB > Gray

# Conclusion

- And the winners are
  - Watershed by area and volume
  - Watershed by dynamics s.t. strongly asymmetric markers
- General tips
  - Prefer 8 neighborhood (k-nearest neighbors ?)
  - Noticeable systematic gain with Lab over RGB
- Generalization?
  - Always hard to tell
  - We measure
    - If an object is present in a hierarchy
    - If it can be retrieved easily



# Conclusion

- Future plans
  - Evaluate more hierarchical representations
  - Incorporate other evaluation frameworks and quality measures
- Marker datasets
  - <http://perso.esiee.fr/~perretb/markerdb/>
- Online demonstration of the interactive segmentation
  - <http://perso.esiee.fr/~perretb/ISeg/>

Interactive segmentation with morphological hierarchies

[Read more](#)

