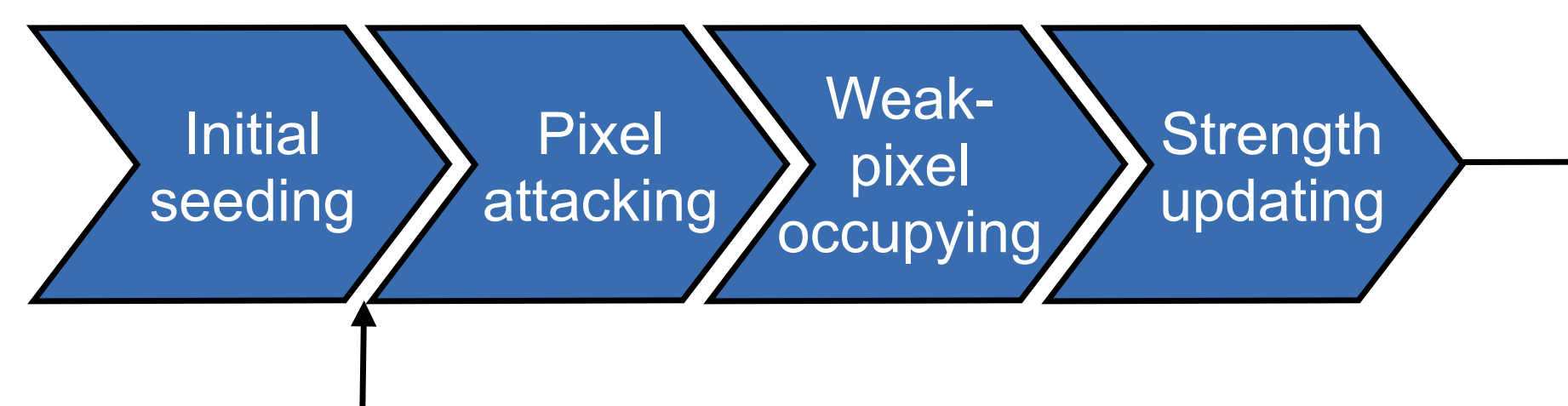


# "RegionCut" - Interactive Multi-Label Segmentation Utilizing Cellular Automaton

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## Problem statement

**Objective:** efficient image segmentation using cellular automaton (GrowCut algorithm [1])



### Properties:

- ✓ user-interactive
- ✓ multi-label capable
- ✓ highly parallelizable
- ➔ but, GrowCut can not compete with state-of-the-art algorithms

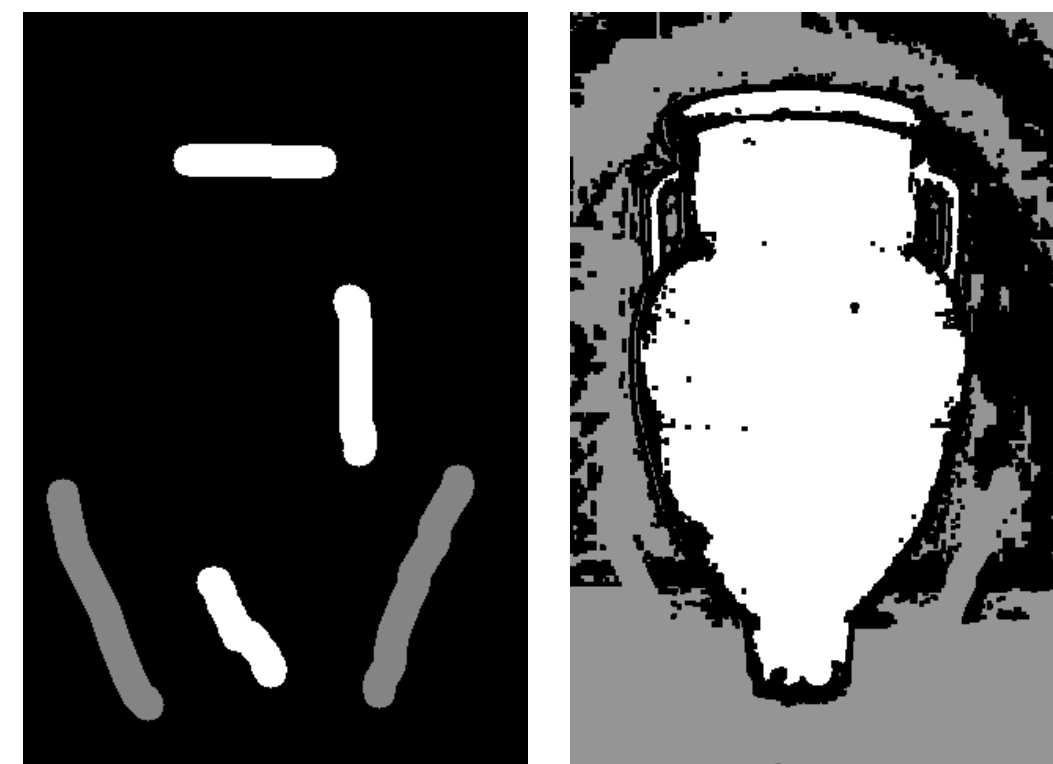
### Issue:

- user initialization requires
- ✗ distributed seeds
- ✗ precise seed positions
- ➔ many seeds are needed

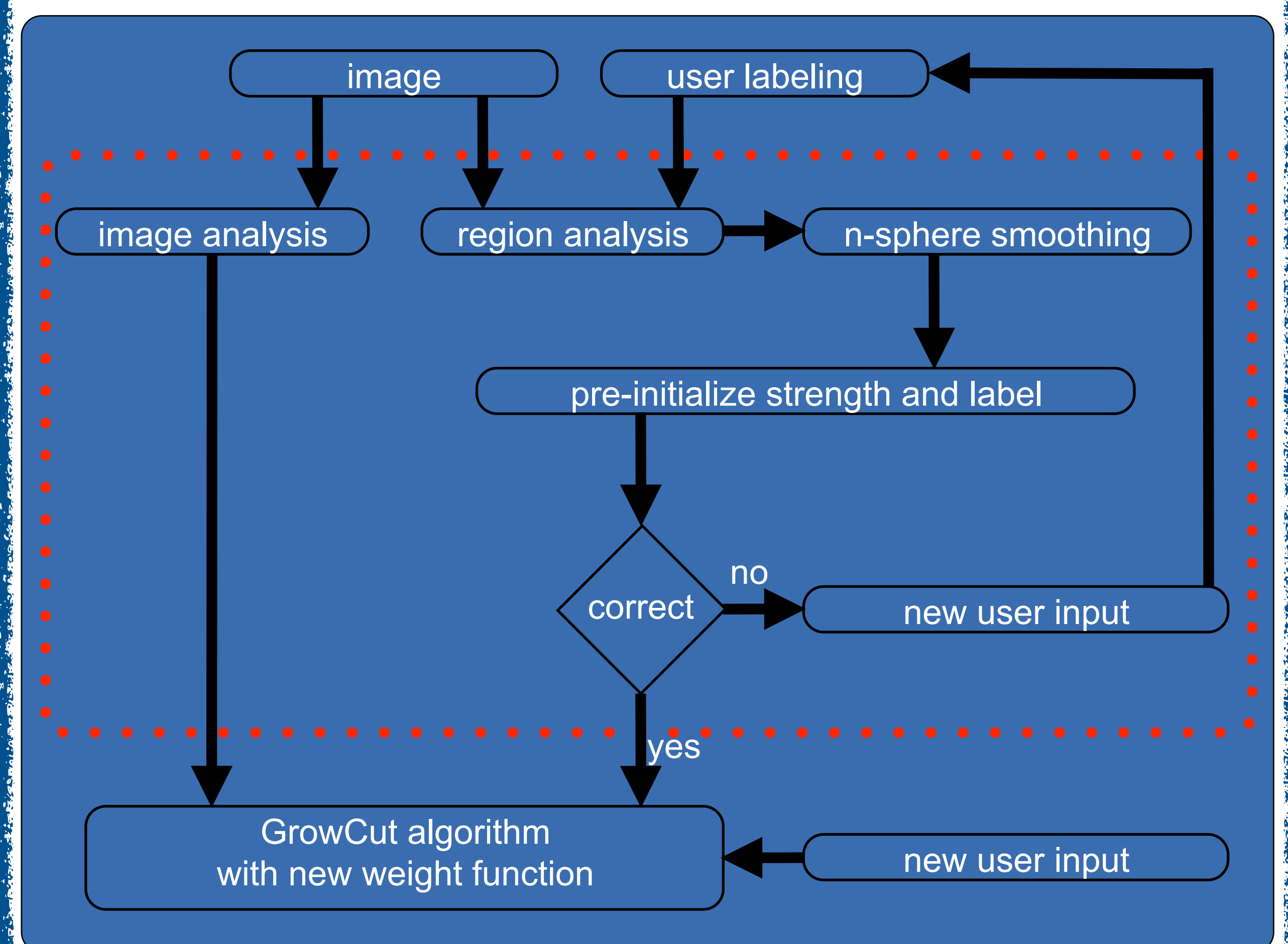


## Contribution I

- ✓ pre-initialize the image iteratively
- ✓ estimate GMM's for each region to compute pixel's label affiliation probabilities
- ✓ use spherical coordinates to smooth probabilities
- ➔ widespread seeds
- ➔ enclosed but non user initialized areas



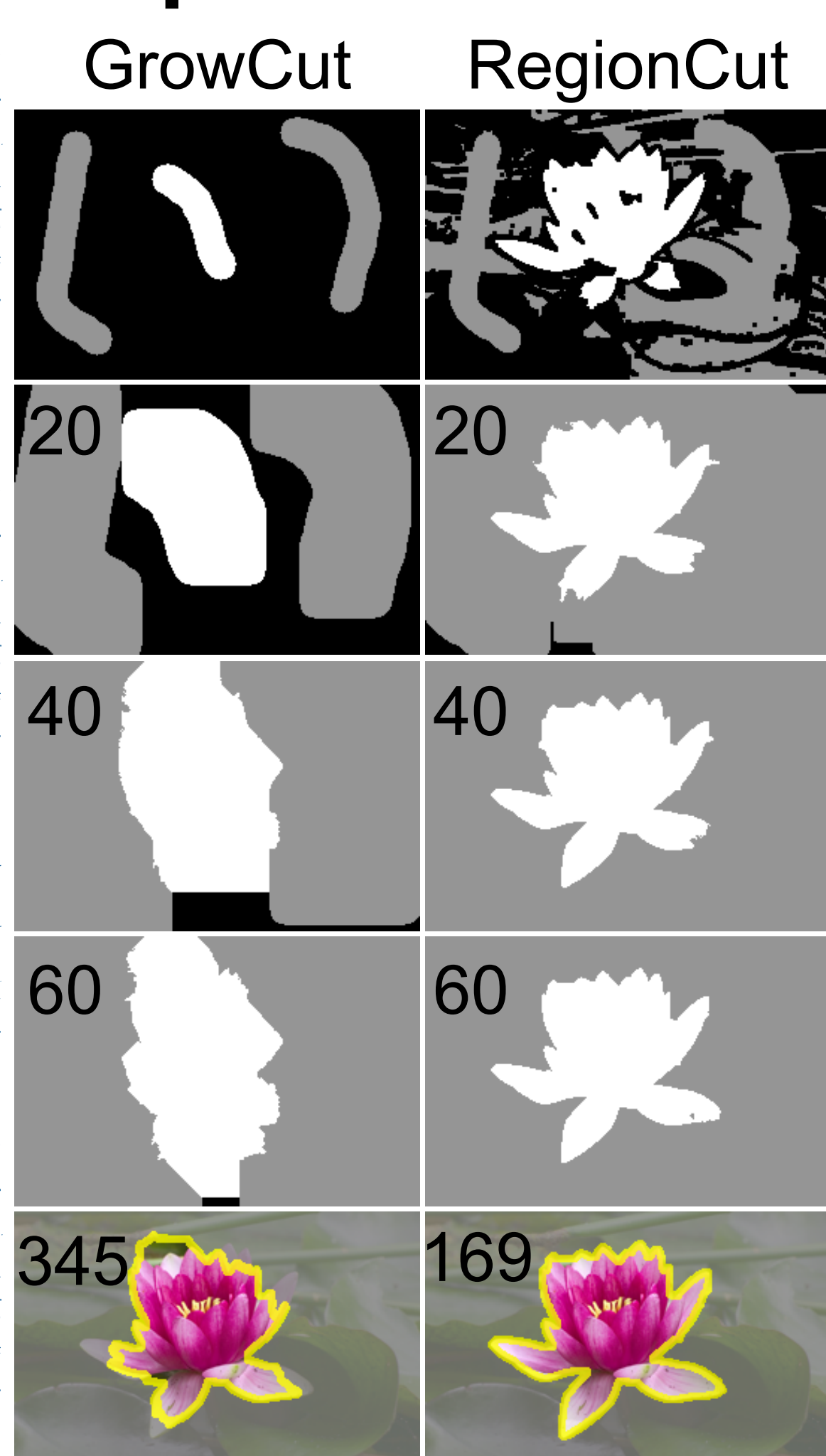
## Workflow



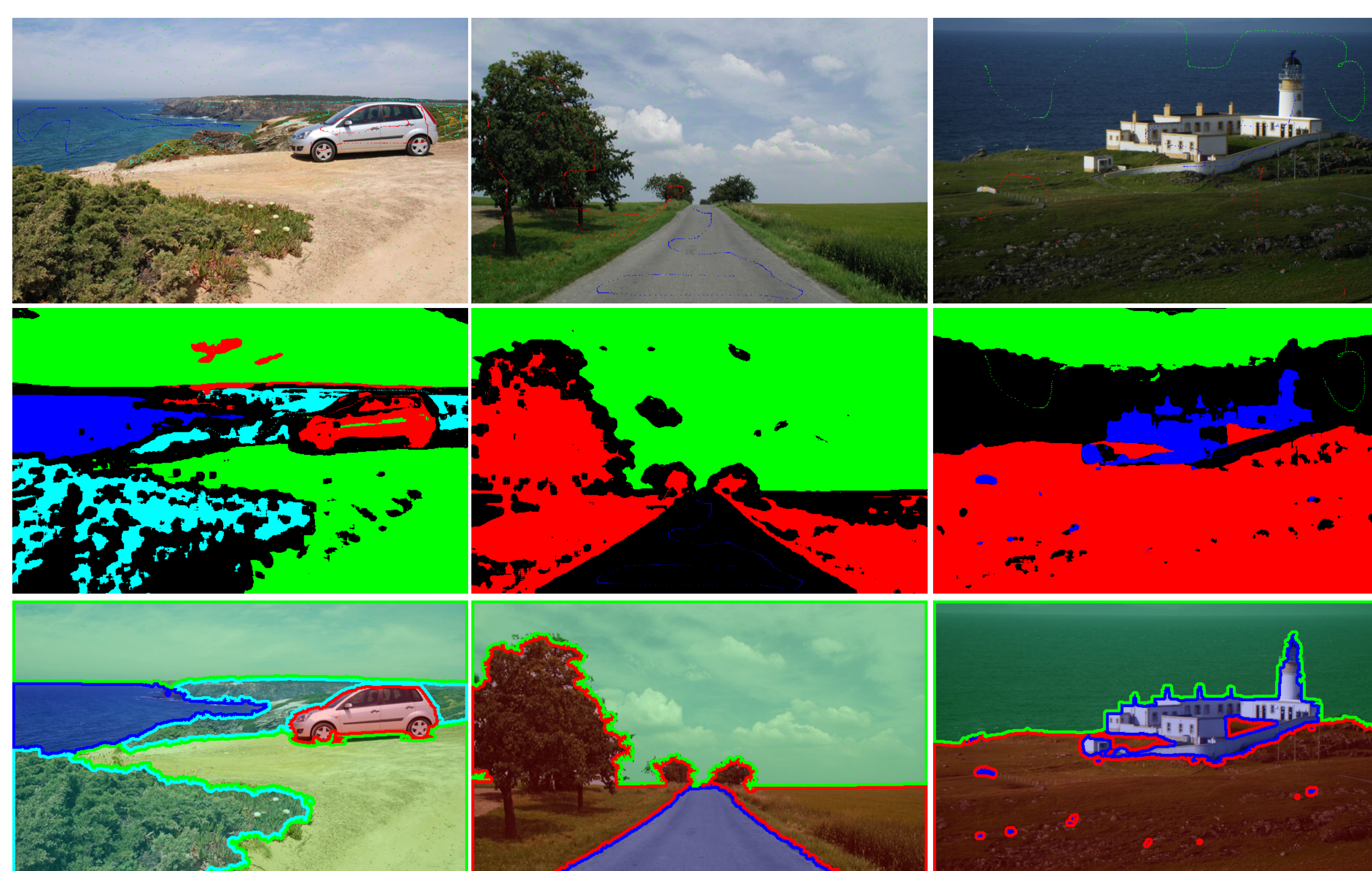
## Contribution II

- ✓ adapt weight function to image characteristics, e.g. brightness, noise, gradients
- $$g(x, l, k) = \frac{l}{2} (1 + \cos(\pi x^k)) + (1 - l) (1 - x)$$
- ➔ parameters are determined automatically by region measures

## Experiments



### multi-label results



## Quantitative Results

Segmentation method	Error rate
GrowCut [1]	11.59 %
GrowCut with new $g$	10.96 %
GrowCut with init	7.19 %
<b>RegionCut</b>	<b>6.46 %</b>
GraphCut [2] ( $\gamma = 50$ )	7.22 %
GraphCut [2] ( $\gamma = 20$ )	7.72 %

- ✓ proposed method outperforms the others (MS segmentation benchmark)
- ✓ multi-label segmentation results competitive to state-of-the-art (lcbBench dataset [3])

## Conclusion

- ✓ pre-initialization using region statistics
- ✓ weight function adaptation based on image characteristics
- ➔ combination of robust region information and precise gradients
- ✓ comparable segmentation error to state-of-the-art algorithms
- ✓ significant speedup compared to GrowCut

## References

- [1] Vezhnevets, V. and Konouchine, V.: Growcut: interactive multi-label nd image segmentation by cellular automata, Graphicon 2005
- [2] Boykov, Y. and Jolly, M.: Interactive graph cuts for optimal boundary & region segmentation of objects in nd images, ICCV 2001
- [3] Santner, J., Pock, T. and Bischof, H.: Interactive multi-label segmentation, ACCV 2010