Superpixel-based Refinement for Object Proposal Generation

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DER FORSCHUNG | DER LEHRE | DER BILDUNG

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ICPR 2020

Segmentation in Object Proposal Generation

Object Proposal Generation (OPG)

Problems of Segmentations in OPG

Proposed Idea

Result w/o our refinement

Result with our refinement

Segmentation in Object Proposal Generation

Object Proposal Generation (OPG)

- Localize and segment all objects in an image
- Class-agnostic proposals in contrast to instance segmentation

Problems of Segmentations in OPG

Proposed Idea

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Segmentation in Object Proposal Generation

Object Proposal Generation (OPG)

Problems of Segmentations in OPG

- State-of-the-art systems segment proposals on coarse resolution (e.g. 10×10 pixels)
- Hundreds of proposals per image

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Object Proposal Generation (OPG)

Problems of Segmentations in OPG

- State-of-the-art systems segment proposals on coarse resolution (e.g. 10×10 pixels)
- Hundreds of proposals per image

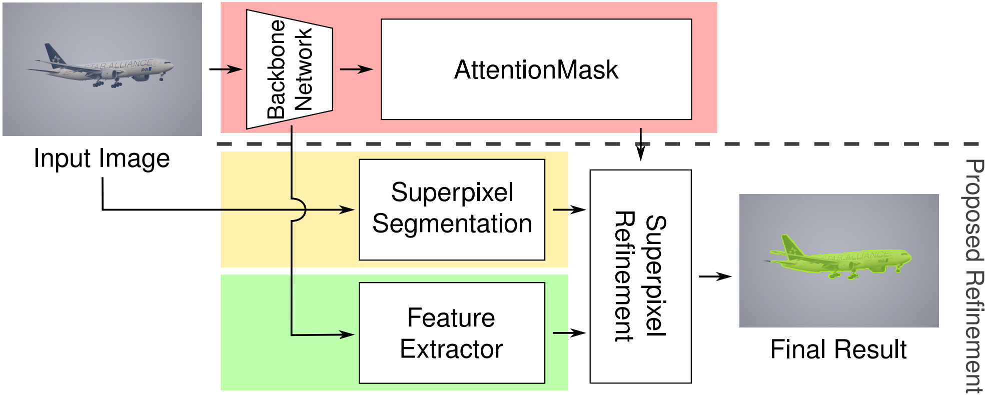
Proposed Idea

- Combine coarse DL-based proposals and fine-grained superpixels
- Classify superpixels as foreground or background

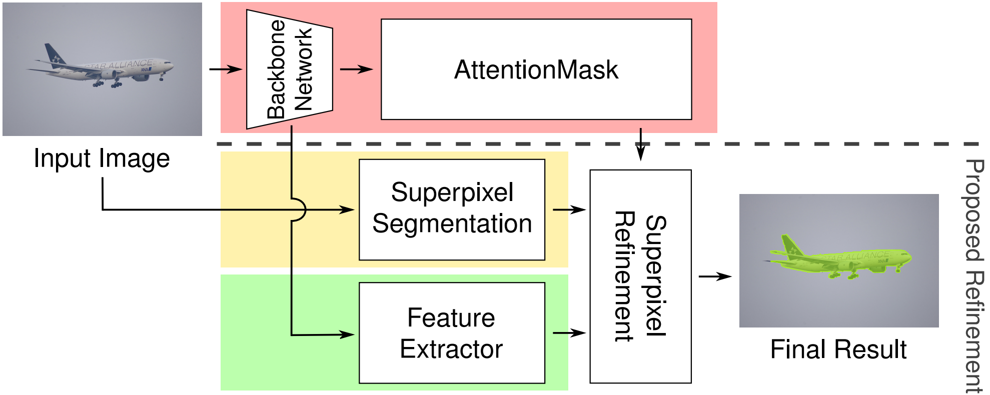
Result w/o our refinement

Result with our refinement

System Overview



System Overview



Generate coarse object proposals with state-of-the-art AttentionMask [Wilms and Frintrop, ACCV'18].

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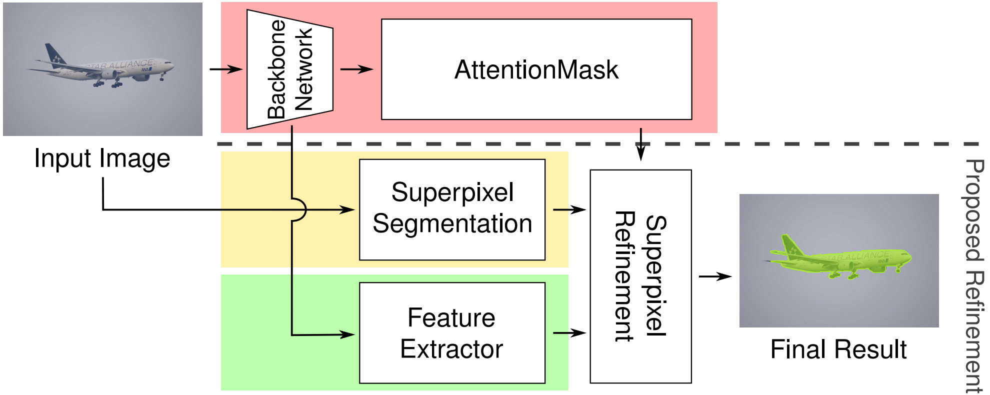

Generate detailed superpixel segmentations [Felzenszwalb and Huttenlocher, IJCV'04] for object proposals of different scales.

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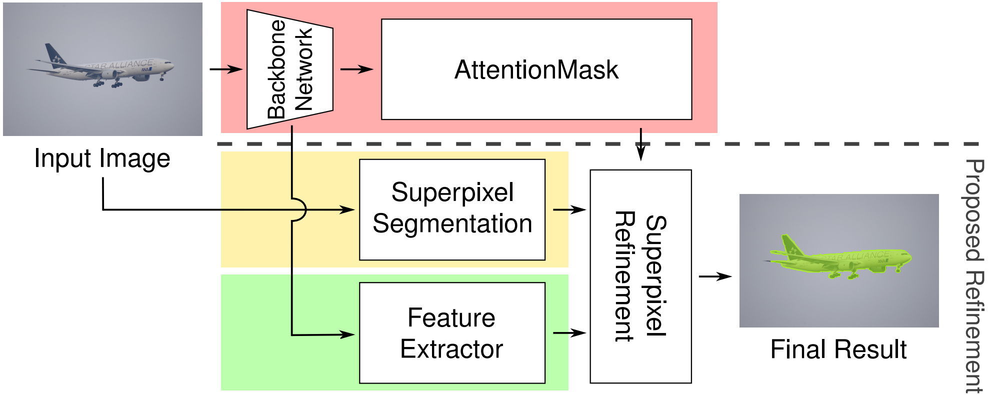
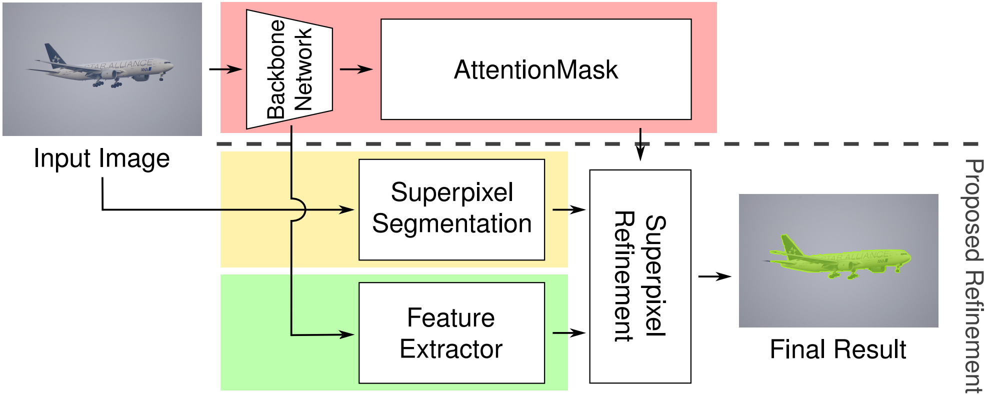


Extract features from the backbone network for object proposals of different scales.

System Overview

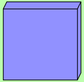


Combine coarse proposals with extracted features using superpixel pooling and classify the superpixels.

Simplified Example

Superpixel Segmentation

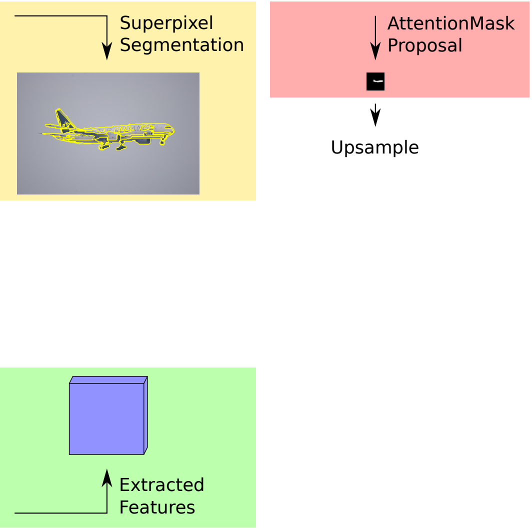
AttentionMask Proposal



Extracted Features

Superpixel Refinement (per Proposal)

Simplified Example



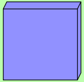
Superpixel Refinement (per Proposal)

- Upsample coarse object proposal mask from AttentionMask

Simplified Example

Superpixel Segmentation

AttentionMask Proposal



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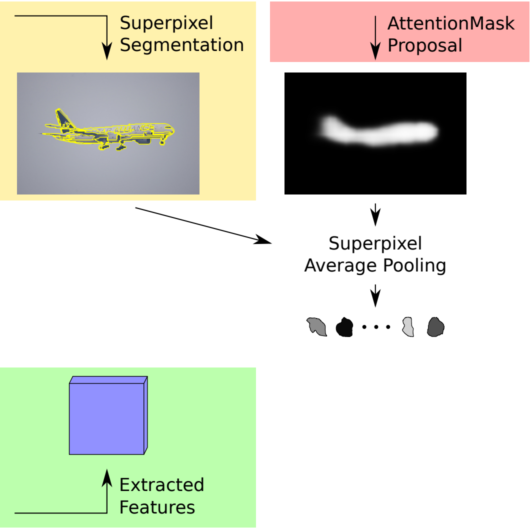
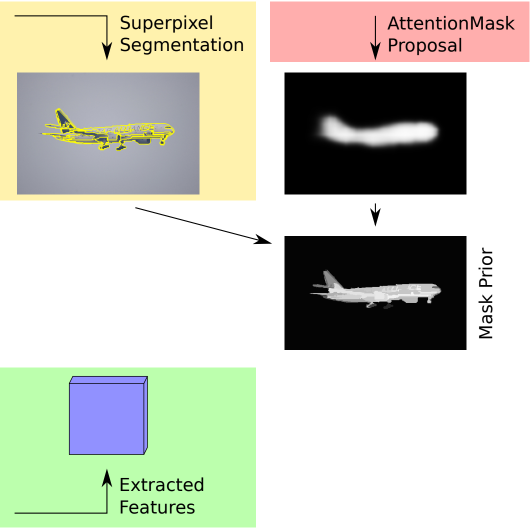


Superpixel Refinement (per Proposal)

- Upsample coarse object proposal mask from AttentionMask
- Superpixel avg. pooling on upsampled results → mask prior: superpixel rather foreground or background

Simplified Example



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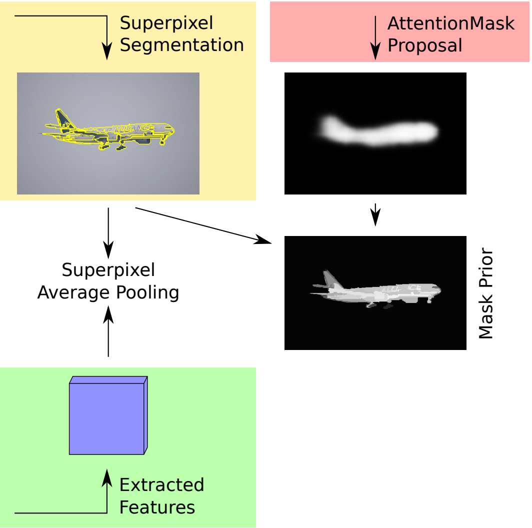

Superpixel Refinement (per Proposal)

- Upsample coarse object proposal mask from AttentionMask
- Superpixel avg. pooling on upsampled results → mask prior: superpixel rather foreground or background
- Superpixel avg. pooling on extracted features → feature vector per superpixel

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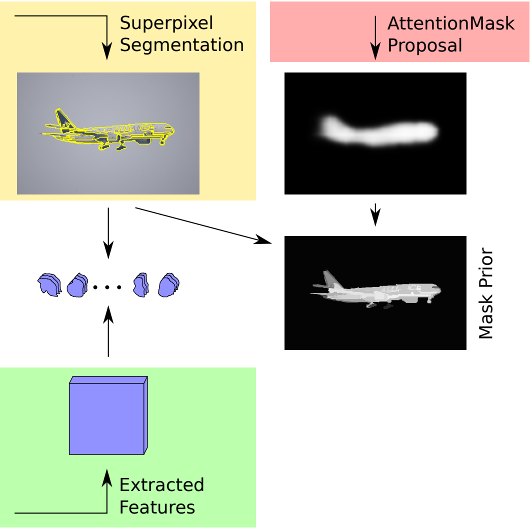

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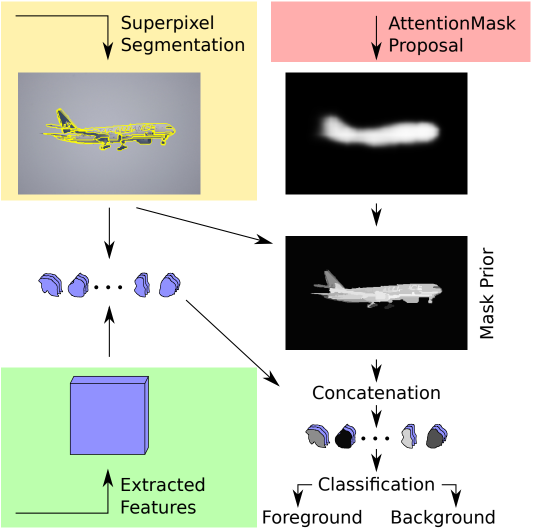

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- Classify each superpixel based on mask prior and feature vector as foreground or background

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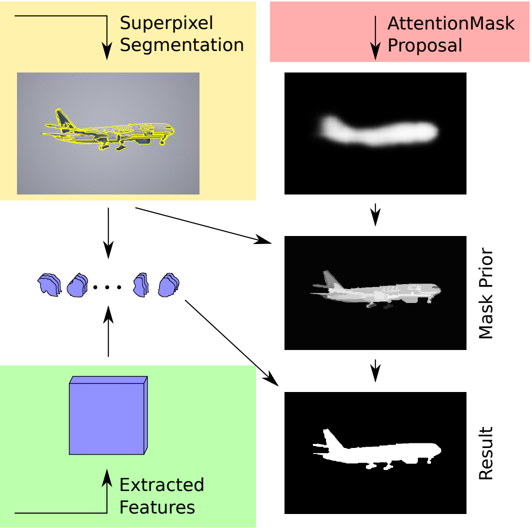

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Quantitative Results on LVIS Dataset

Method	AR@10	AR@100
DeepMask [Pinheiro et al., NIPS'15]	0.069	0.147
SharpMask [Pinheiro et al., ECCV'16]	0.073	0.154
FastMask [Hu et al., CVPR'17]	0.069	0.161
AttentionMask [Wilms and Frintrop, ACCV'18]	0.073	0.189
Ours	**0.092**	**0.206**

- LVIS has COCO images with more precise annotations
- AR@N: Average Recall for N proposals

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Method	BR↑	UE↓
DeepMask	0.488	0.087
SharpMask	0.561	0.080
FastMask	0.510	0.084
AttentionMask	0.568	0.070
Ours	**0.681**	**0.068**

- LVIS has COCO images with more precise annotations
- AR@N: Average Recall for N proposals
- BR: Boundary Recall
- UE: Undersegmentation Error

Qualitative Results on LVIS Dataset




AttentionMask | Ours | Ground Truth

Qualitative Results on LVIS Dataset

AttentionMask Ours Ground Truth

Summary

- Object proposals mostly have only coarse segmentations
- Superpixel-based refinement
- Combination of coarse masks, DL features and superpixels
- Improvement in general object proposal results
- Better adherence to object boundaries

Conclusion

Superpixels can be helpful in combination with DL!

Result w/o our refinement

Result with our refinement

Thank you for your attention!

Visit our poster in session **PS T5.6** on **Thursday**, 14 January

LA 07:00 am

New York 10:00 am

CET 04:00 pm

Beijing 11:00 pm

Sydney 02:00 am

Web page with **Code and Paper**

www.inf.uni-hamburg.de/spxrefinement