Technische Hochschule Nürnberg

CVPR JUNE 17-21, 2024 SEATTLE, WA

# Hierarchical Histogram Threshold Segmentation

## Auto-terminating High-detail Oversegmentation


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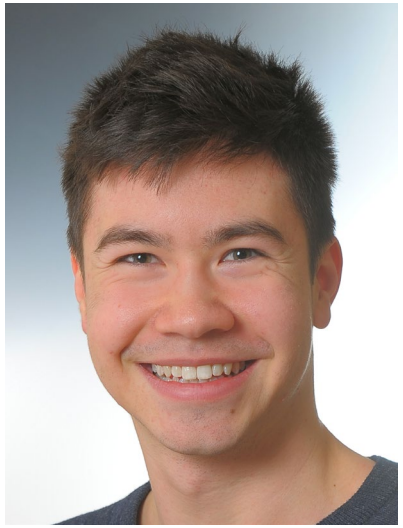

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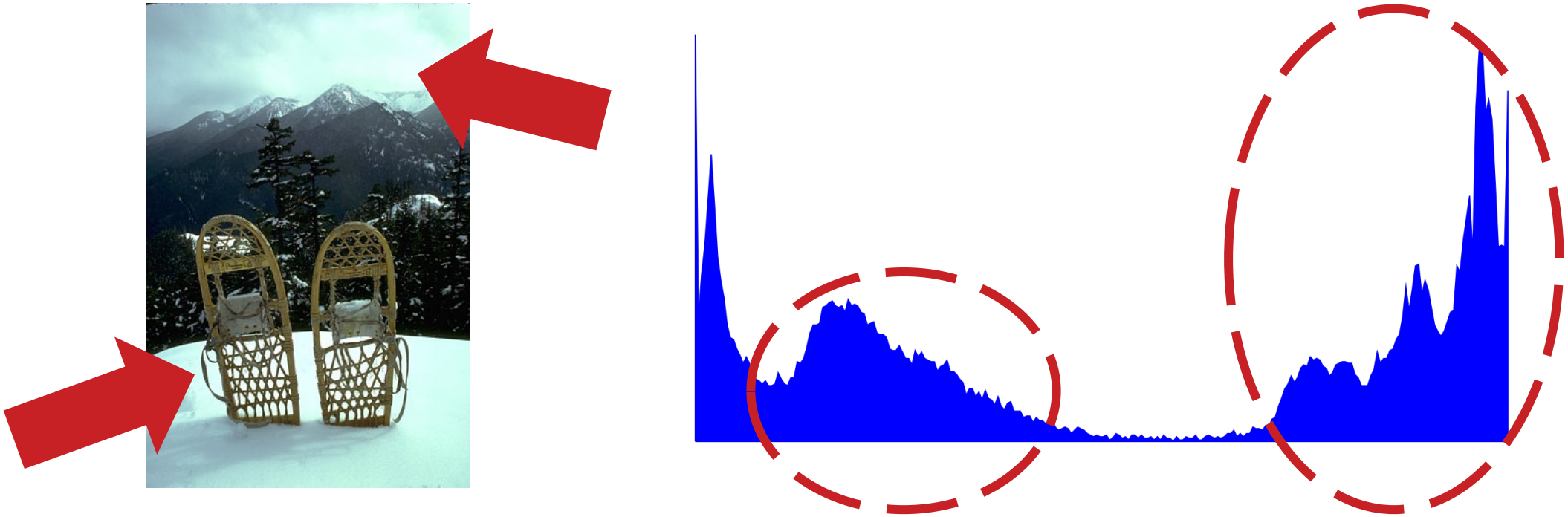
Federal Ministry of Education and Research

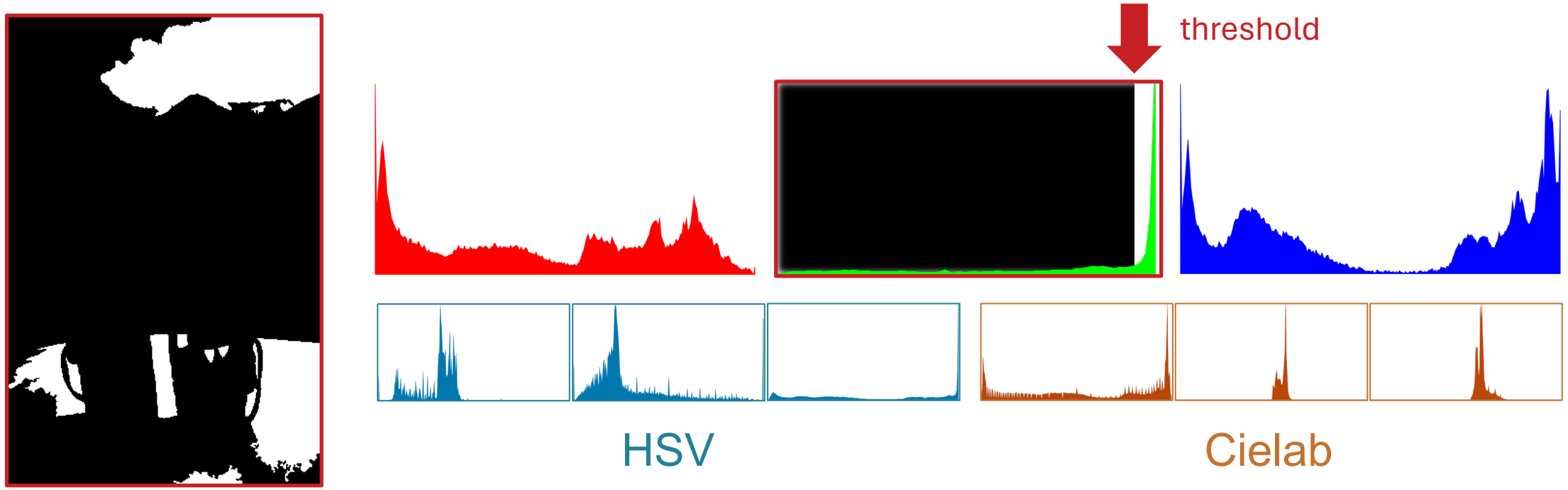
# Key Idea

- Assumption: Color histogram clusters correspond to object classes



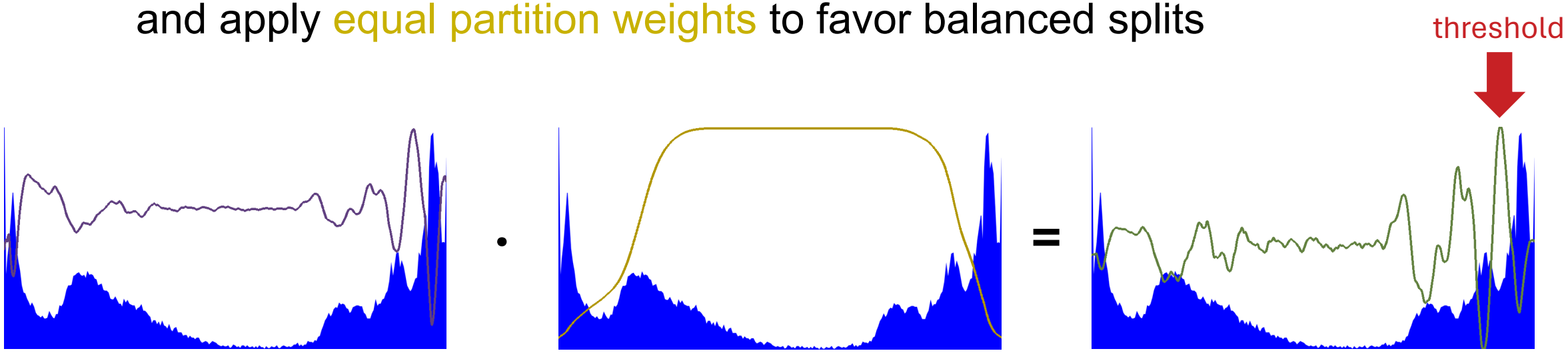
# Key Idea

- Usage: Separate object classes by color intensity thresholding at histogram cluster boundaries across multiple color channels



# Key Idea

- Thresholding: 1D Laplace filter to find object class boundaries and apply equal partition weights to favor balanced splits




**Laplace Kernel**

$$[1 \quad -2 \quad 1]$$

**Cauchy Distribution**

$$\left[\left(2 - \frac{4\hat{h}_i}{\hat{h}_{b-1}}\right)^4 + 1\right]^{-1}$$

**Threshold Applicability**

# Key Idea

- Progression: Hierarchically split color-inhomogeneous segments into more homogeneous ones (until color information exhaustion)

# Experiments

- Segmentation results for 500 superpixels – BSDS500 dataset

SEEDS

ETPS

**HHTS**

# Experiments

- Segmentation results for 500 superpixels – BSDS500 dataset

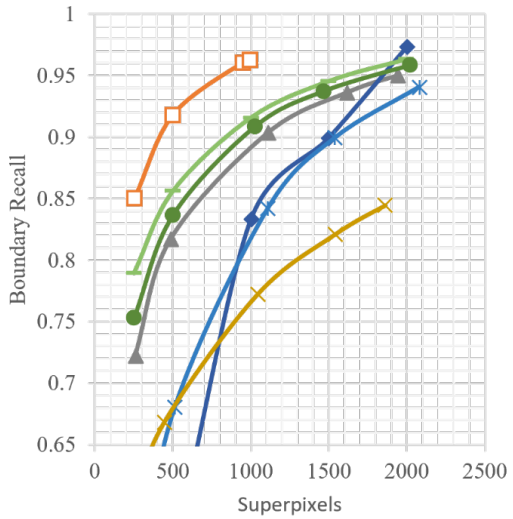
CRS - **HHTS**

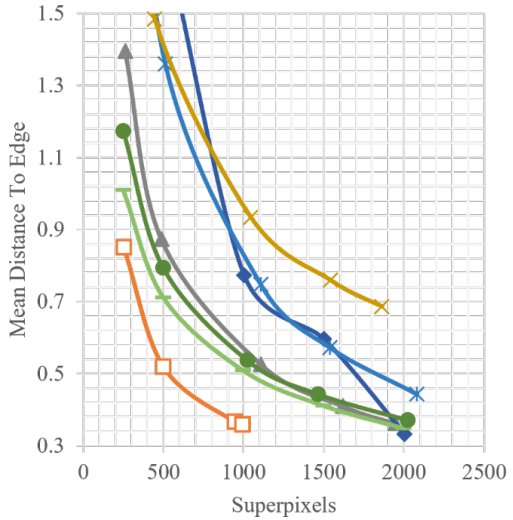
SLIC - **HHTS**

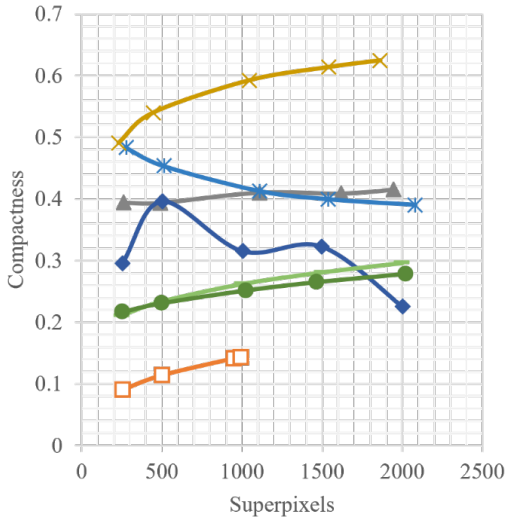
ERGC - **HHTS**

# Experiments

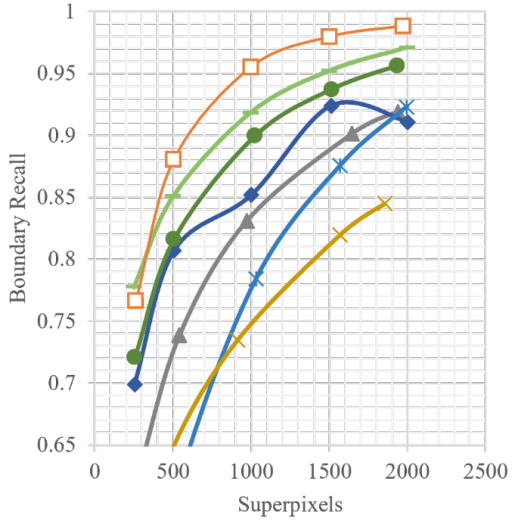
BSDS500

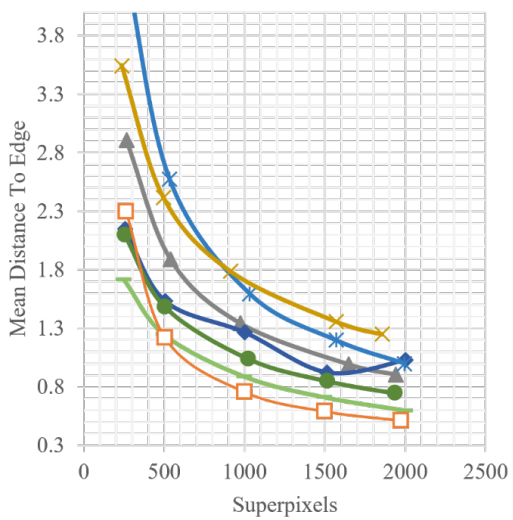


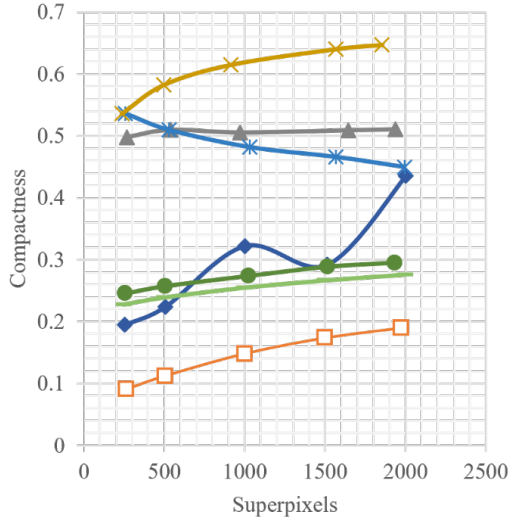



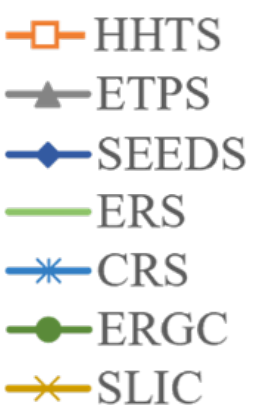




NYUV2



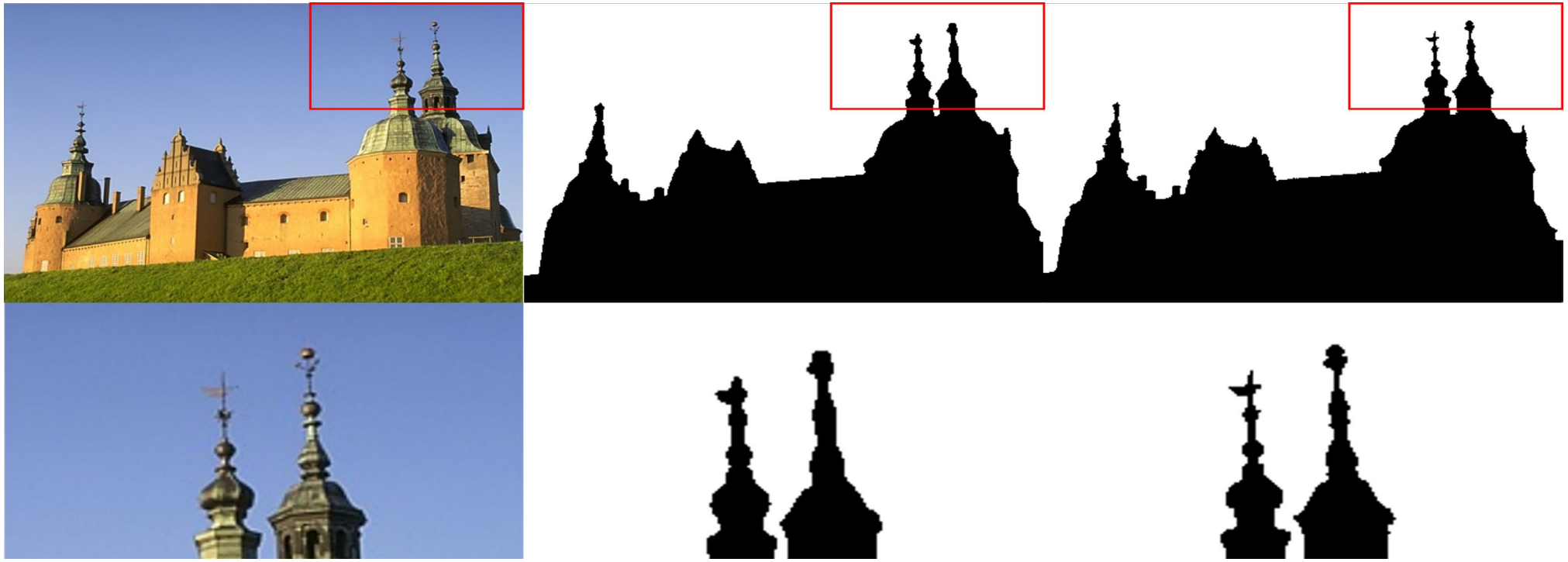
# Experiments

| Superpixels | Method | UE | BR | ASA | EV | CO | BP |
|---|---|---|---|---|---|---|---|
| 250 | SH | 0.0970 | 0.8080 | **0.9510** | | | |
| | HHTS | **0.0668** | **0.8502** | 0.9332 | | | |
| 600 | SCAC | 0.0680 | 0.8260 | **0.9660** | 0.8750 | **0.4420** | |
| | HHTS | **0.0373** | **0.9326** | 0.9627 | **0.8989** | 0.1215 | |
| 1000 | VSSS | 0.0324 | 0.9188 | 0.9676 | **0.9123** | **0.1953** | |
| | HHTS | **0.0307** | **0.9626** | **0.9693** | 0.9100 | 0.1411 | |
| 1200 | APENet | | 0.9204 | **0.9758** | | | **0.1878** |
| 1000* | HHTS | | **0.9626** | 0.9693 | | | 0.0744 |
| 1300 | LDFUNet | | 0.9300 | **0.9734** | | | **0.0996** |
| 1000* | HHTS | | **0.9626** | 0.9693 | | | 0.0744 |
| 2000 | CRTREES | 0.0716 | 0.9624 | | **0.9482** | | |
| 1000* | HHTS | **0.0307** | **0.9626** | | 0.9100 | | |

BSDS500: HHTS vs. state-of-the-art superpixel methods
* Indicates HHTS early auto-termination

# Application

- Refine semantic masks (e.g., Segment Anything Model – SAM)



SAM mask + **HHTS** refinement

# Conclusion

- HHTS – auto-terminating and high-detail oversegmentation method
- Separate visually distinct objects based on local color histograms
- Find thresholds by combining Laplace filter and equal partitions
- Superior boundary adherence, suitable for thin structures and details
- Reduced input parameter dependencies (initialization, termination)

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**Funding**

**Contact**

**Project page**