# Localizing Visual Sounds the Easy Way

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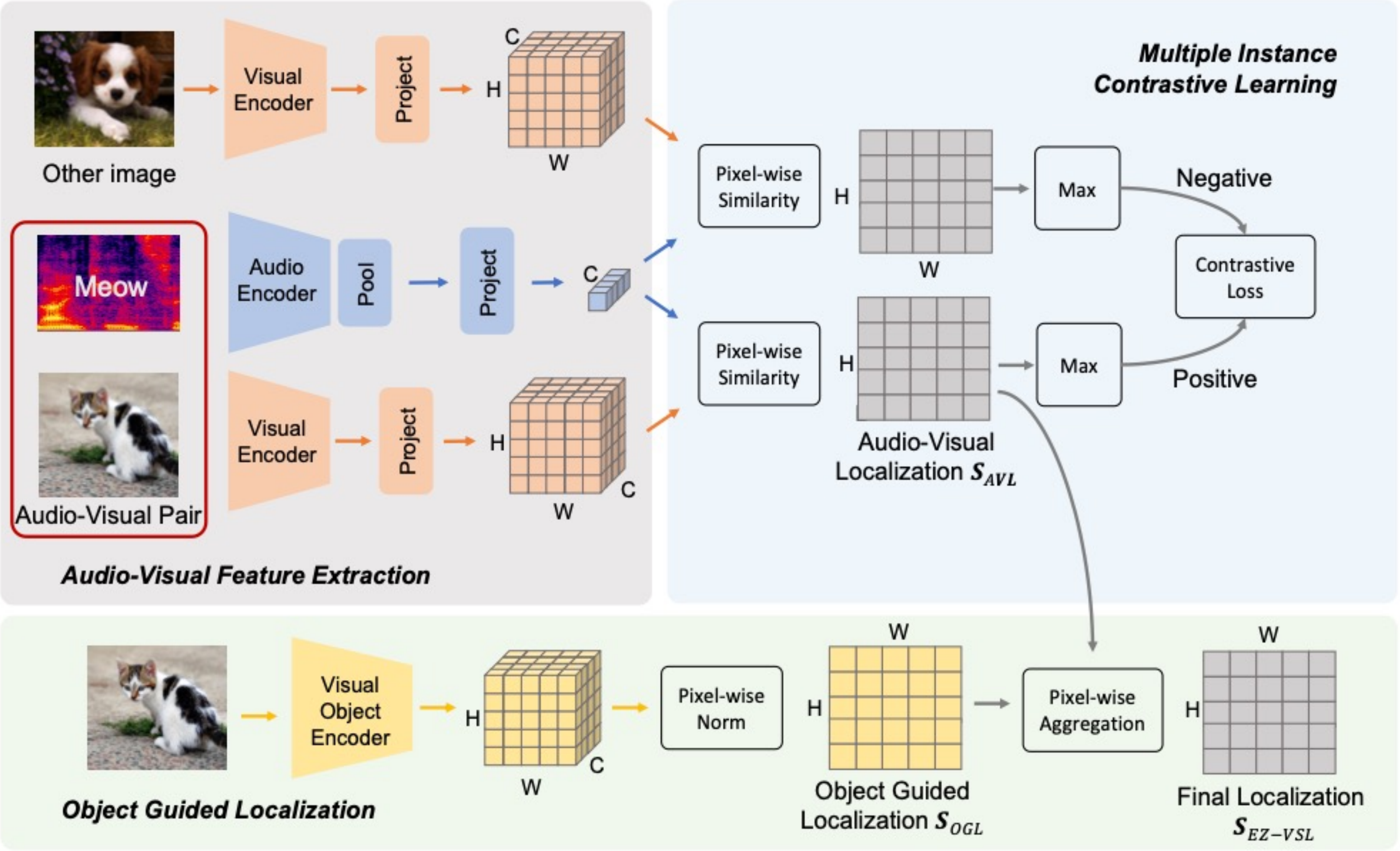
**Code & pre-trained models are available:**
https://github.com/stoneMo/EZ-VSL

## Contributions

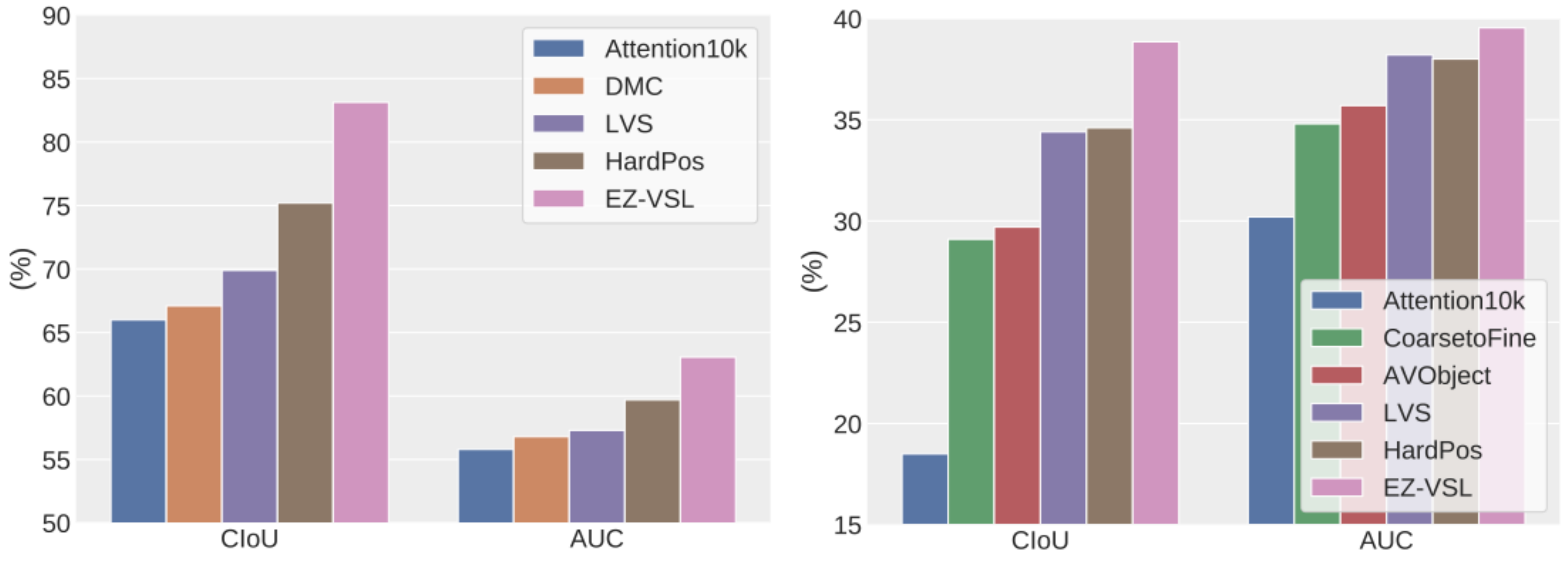
✦ We present a simple yet effective multiple instance learning framework for unsupervised sound source visual localization, which we call **EZ-VSL**.

✦ We propose a novel **object-guided localization** scheme that favors object regions, which are more likely to contain sound sources.



- **Training**: the audio-visual feature extractor computes global audio and localization visual features. Audio-visual alignment is learned by a *multiple instance contrastive learning* objective.
- **Inference**: At inference time, we use another visual encoder pre-trained on object recognition to compute object localization maps, which are combined with audio-visual localization maps for the final prediction.

## Comparison with state-of-the-arts

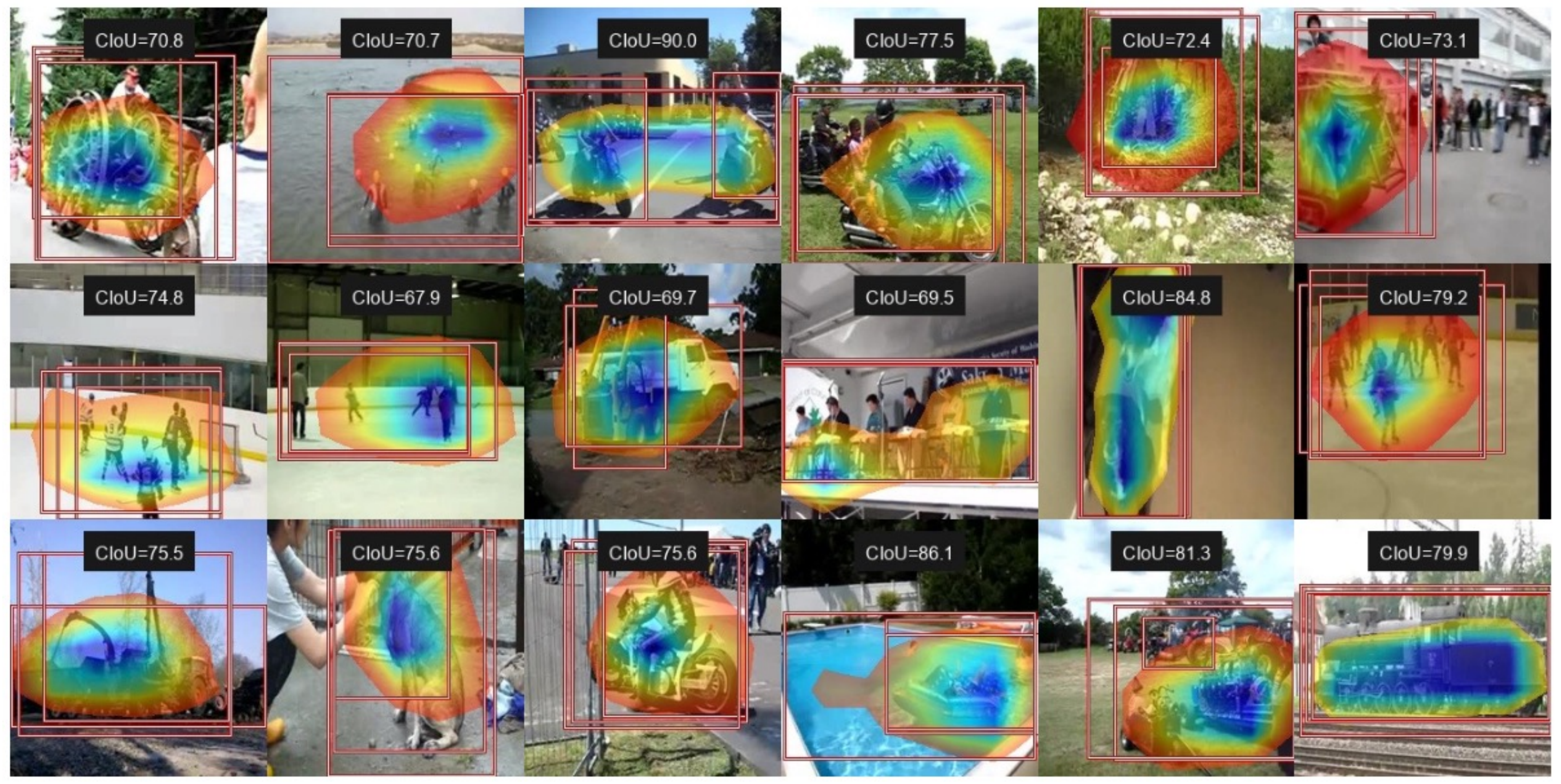


(a) Flick SoundNet (b) VGG Sound Sources

## Ablation Study

| AVL | L1-OGL | CLS-OGL | Flickr SoundNet | | VGG-SS | |
|---|---|---|---|---|---|---|
| | | | CIoU(%) | AUC(%) | CIoU(%) | AUC(%) |
| ✓ | | | 78.31 | 61.74 | 35.96 | 38.20 |
| | ✓ | | 78.31 | 61.17 | 36.77 | 38.69 |
| | | ✓ | 75.10 | 58.18 | 35.13 | 38.08 |
| ✓ | | ✓ | 81.93 | 62.50 | 38.58 | 39.59 |
| ✓ | ✓ | | **83.94** | **63.60** | **39.34** | **39.78** |

## Qualitative Visualizations



## Cross-dataset Generalization

| Test set | Training set | Method | CIoU(%) | AUC(%) |
|---|---|---|---|---|
| Flickr SoundNet | VGG-Sound 10k | LVS [6] | 61.80 | 53.60 |
| | | EZ-VSL | **78.71** | **61.56** |
| | VGG-Sound 144k | LVS [6] | 71.90 | 58.20 |
| | | EZ-VSL | **84.34** | **63.77** |
| | VGG-Sound Full | LVS [6] | 73.59 | 59.00 |
| | | EZ-VSL | **83.94** | **63.60** |
| VGG-SS | Flickr 10k | LVS [6] | 18.71 | 30.29 |
| | | EZ-VSL | **35.54** | **38.18** |
| | Flickr 144k | LVS [6] | 26.95 | 34.30 |
| | | EZ-VSL | **38.62** | **39.20** |

## Open Set Source Localization

| Test class | Method | CIoU(%) | AUC(%) |
|---|---|---|---|
| Heard 110 | LVS [6] | 28.90 | 36.20 |
| | EZ-VSL | **37.25** | **38.97** |
| Unheard 110 | LVS [6] | 26.30 | 34.70 |
| | EZ-VSL | **39.57** | **39.60** |

## A-V Matching Strategies

| AV matching strategy | Flickr SoundNet | | VGG-SS | |
|---|---|---|---|---|
| | CIoU(%) | AUC(%) | CIoU(%) | AUC(%) |
| $\texttt{sim}(\text{MaxPool}_{xy}(V_{xy}), A)$ | 49.40 | 48.97 | 12.72 | 27.10 |
| $\text{AvgPool}_{xy}(\texttt{sim}(V_{xy}, A))$ | 33.33 | 37.56 | 6.03 | 19.44 |
| $\text{MaxPool}_{xy}(\texttt{sim}(V_{xy}, A))$ | **78.31** | **61.74** | **35.96** | **38.20** |

## Project Website

Feel free to scan for more details!

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