A Brief Analysis of SLAVC method for Sound Localization

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Gloria Haro

IPOL Journal · Image Processing On Line

Universitat Pompeu Fabra Barcelona

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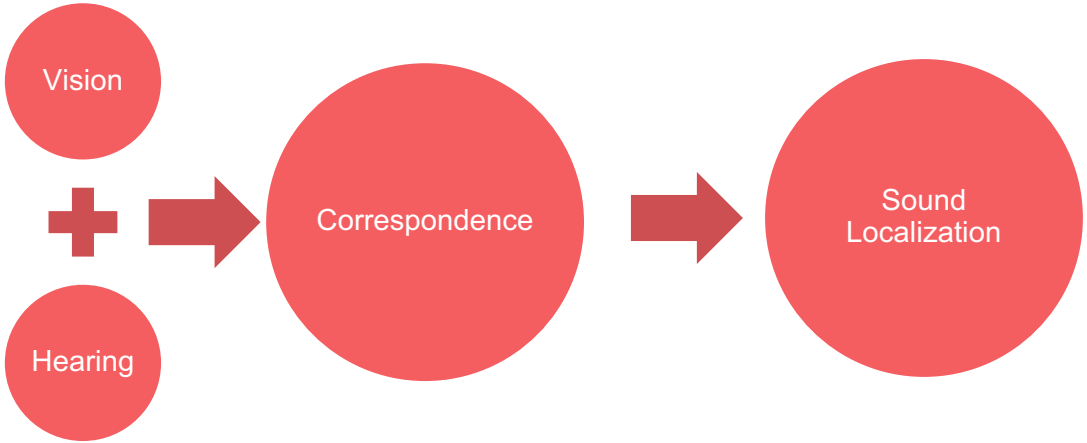
1. INTRODUCTION



Fundamental aspect of human perception

- Navigate our environment
- Communicate
- Respond to potential threats

1. INTRODUCTION

Hershey and Movellan [1], Fisher et al. [2] and Kidron et al. [3] → Model based correspondences between visual features and audio features

Arandjelovic and Zisserman [4] Senocak et al. [5] and Hu et al. [6] → Used Contrastive Learning to localize objects aligning visual and audio representations

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2 Major flaws: →

1. Rely on Early-stopping to avoid overfitting.
2. Assumed all sound sources are present in the scene

→ Incorrectly identifying false positives

→ Recent Works identify silent objects and off-screen sounds (Hu et al. [7] and Liu et al. [8]

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SLAVC —solves→

- Overfitting → Heavy visual dropout + Momentum encoders
- Hallucinating visible sound objects →
  1. Visual Sound Localization Term
  2. Audio - Visual Correspondence Term

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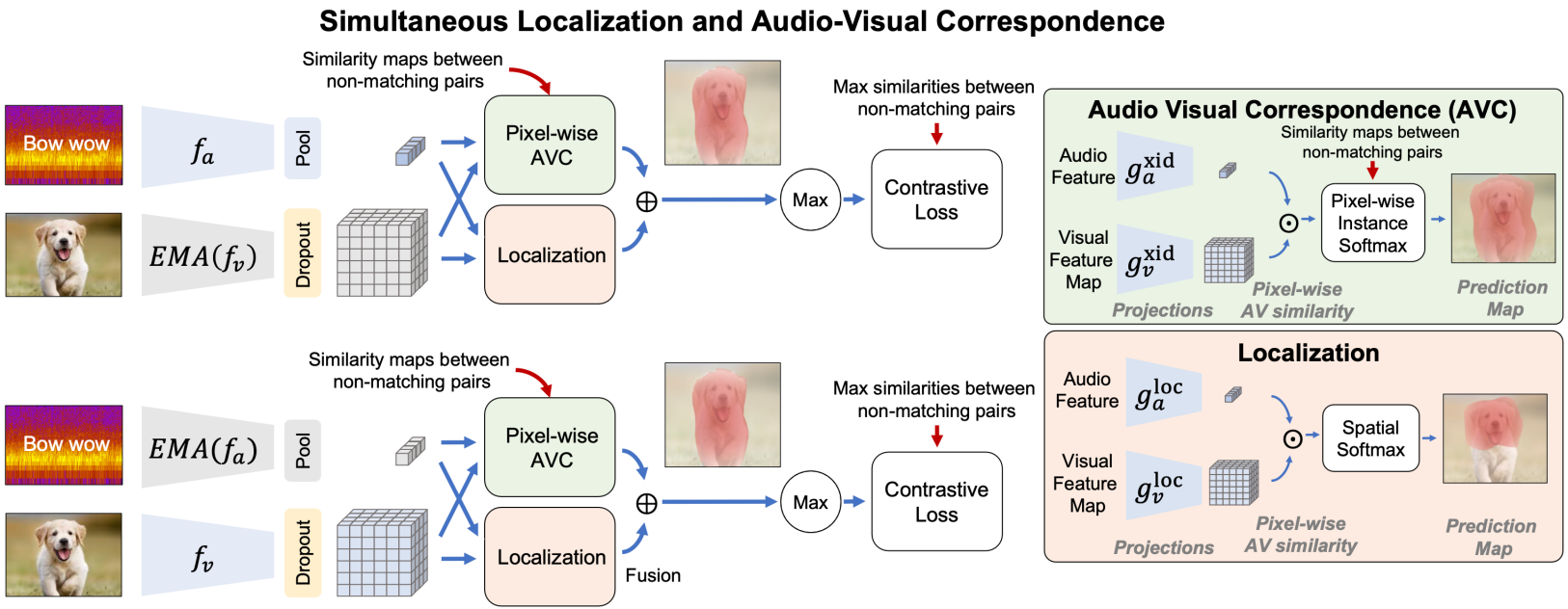
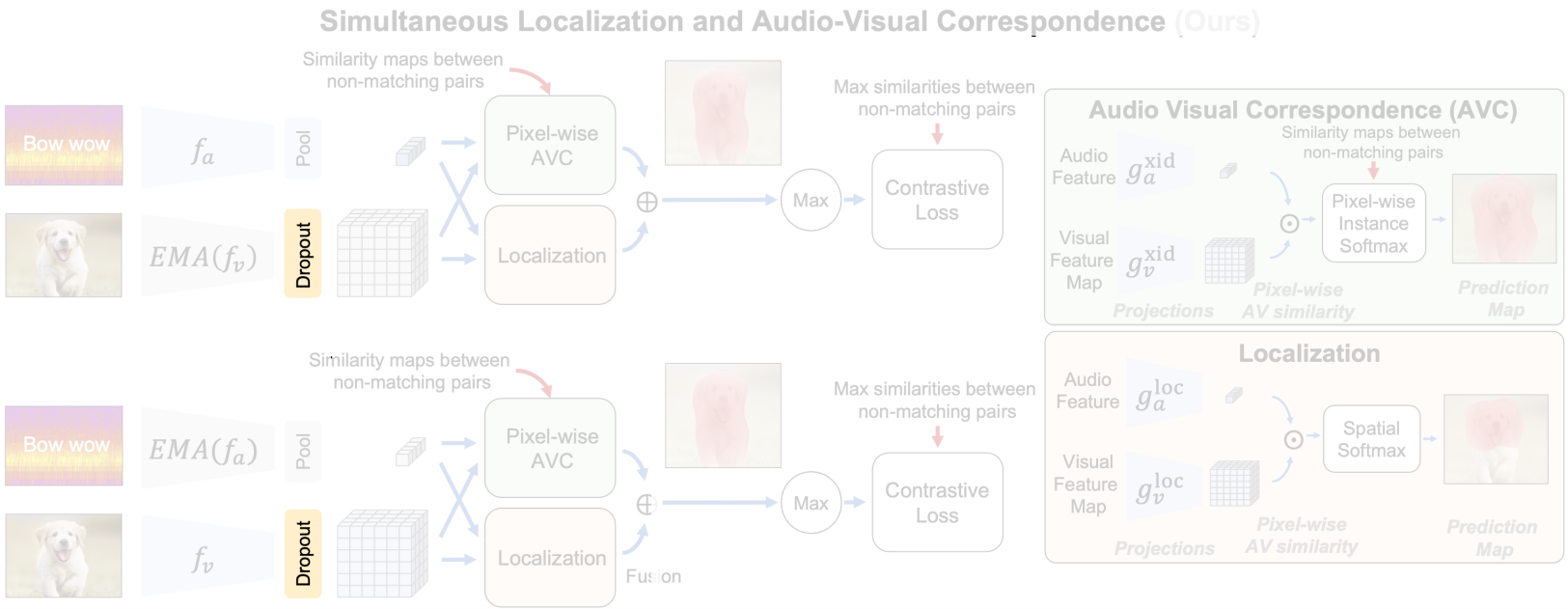
2. METHOD

SLAVC



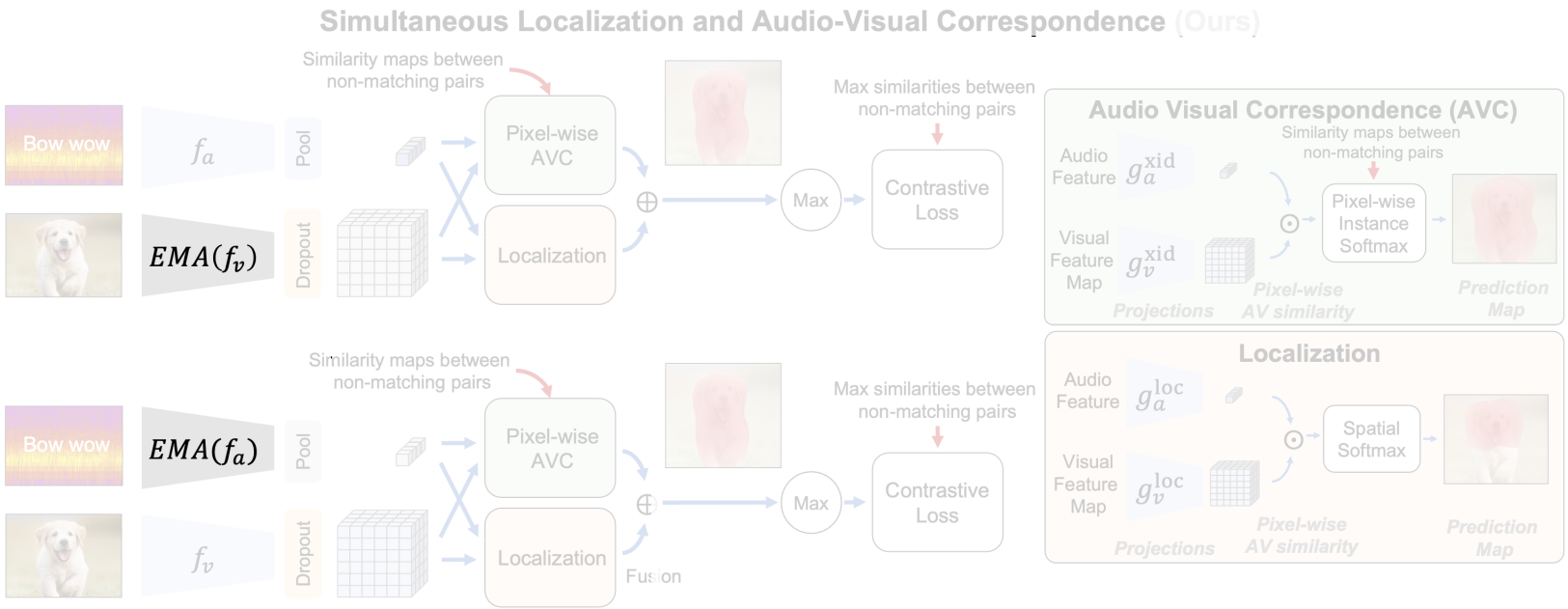
2. METHOD

SLAVC → Overfitting → Heavy visual **dropout** + Momentum encoders



2. METHOD

SLAVC → Overfitting → Heavy visual dropout + **Momentum encoders**

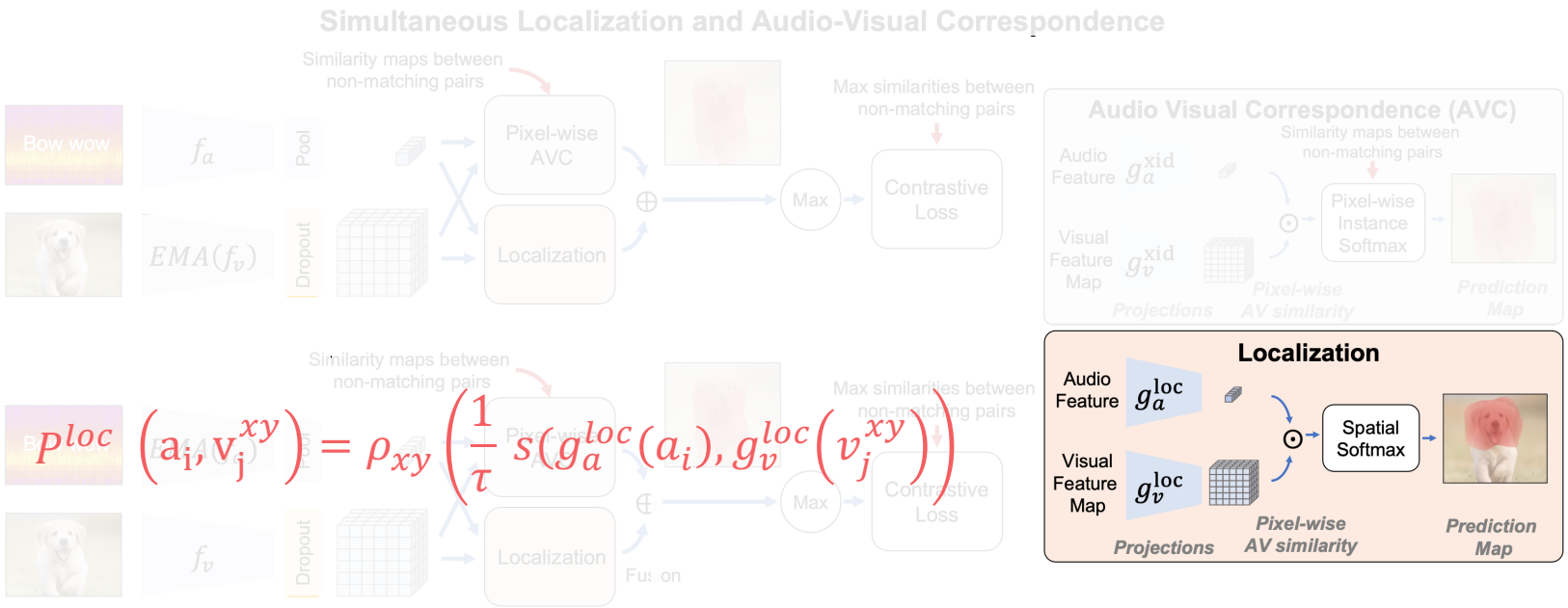


2. METHOD

SLAVC →

Overfitting → Heavy visual dropout + Momentum encoders

Hallucinating visible sound objects → 1. **Visual Sound Localization Term**



$$P^{loc}\left(a_i, v_j^{xy}\right) = \rho_{xy}\left(\frac{1}{\tau} s\left(g_a^{loc}(a_i), g_v^{loc}\left(v_j^{xy}\right)\right)\right)$$

2. METHOD

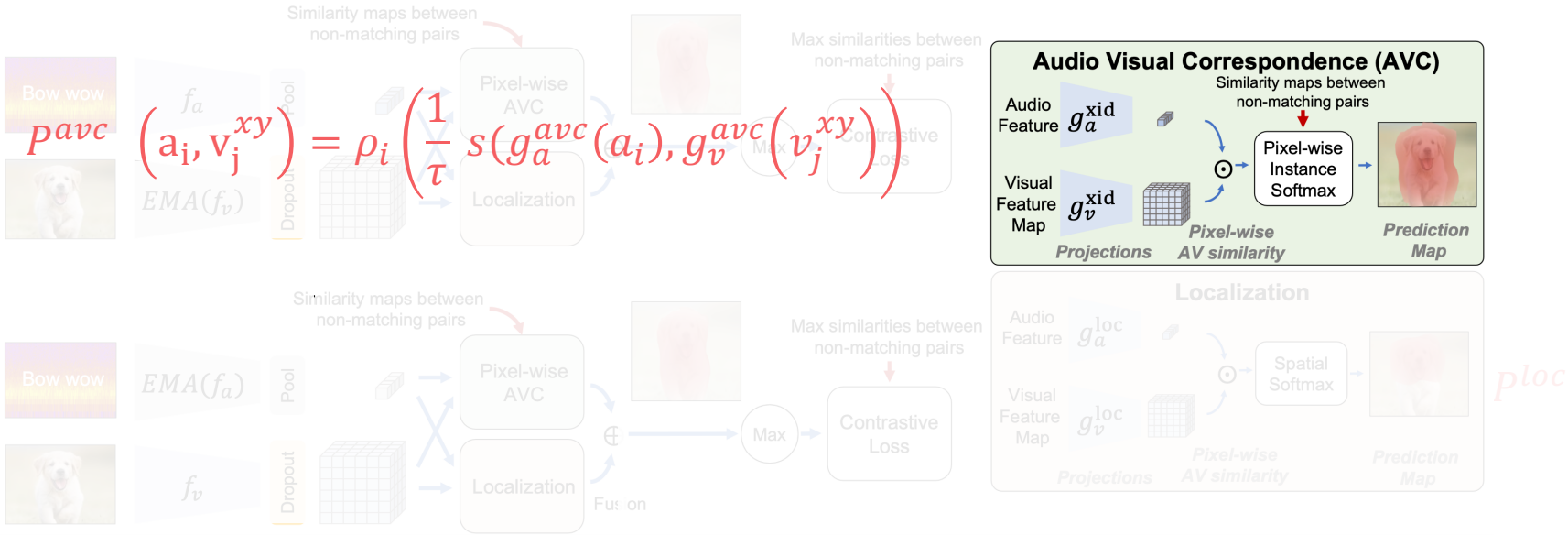
SLAVC →

Overfitting → Heavy visual dropout + Momentum encoders

Hallucinating visible sound objects →

1. Visual Sound Localization Term
2. **Audio - Visual Correspondence Term**

Simultaneous Localization and Audio-Visual Correspondence



$$p^{avc}\left(a_i, v_j^{xy}\right) = \rho_i\left(\frac{1}{\tau} s\left(g_a^{avc}(a_i), g_v^{avc}\left(v_j^{xy}\right)\right)\right)$$

2. METHOD

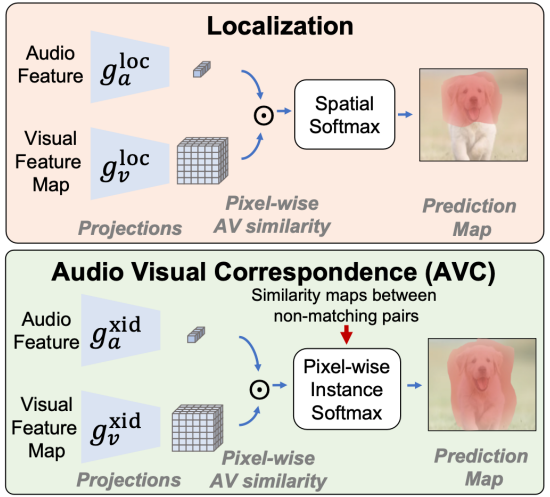
SLAVC

Overfitting → Heavy visual dropout + Momentum encoders

Hallucinating visible sound objects →
1. Visual Sound Localization Term
2. Audio - Visual Correspondence Term

$$P^{loc}\left(a_i, v_j^{xy}\right) = \boldsymbol{\rho_{xy}}\left(\frac{1}{\tau}\, s(g_a^{loc}(a_i), g_v^{loc}\left(v_j^{xy}\right)\right)$$

$$P^{avc}\left(a_i, v_j^{xy}\right) = \boldsymbol{\rho_i}\left(\frac{1}{\tau}\, s(g_a^{avc}(a_i), g_v^{avc}\left(v_j^{xy}\right)\right)$$



2. METHOD

SLAVC

Overfitting → Heavy visual dropout + Momentum encoders

Hallucinating visible sound objects →
1. Visual Sound Localization Term
2. Audio - Visual Correspondence Term

$$P^{SLAVC}\left(a_i, v_j^{xy}\right) = P^{loc}\left(a_i, v_j^{xy}\right) \cdot P^{avc}\left(a_i, v_j^{xy}\right)$$

2. METHOD

SLAVC

Overfitting → Heavy visual dropout + Momentum encoders

Hallucinating visible sound objects →
1. Visual Sound Localization Term
2. Audio - Visual Correspondence Term

$$P^{SLAVC}\left(a_i, v_j^{xy}\right) = P^{loc}\left(a_i, v_j^{xy}\right) \cdot P^{avc}\left(a_i, v_j^{xy}\right)$$

$$S_{VSL}^{xy} = \alpha S_{SLAVC}^{xy} + (1-\alpha) S_{OGL}^{xy}$$

S_{OGL}^{xy} → Object Guided Localization (OGL)

S_{VSL}^{xy} → Visual Sound Localization (VSL)

2. METHOD

SLAVC

Overfitting → Heavy visual dropout + Momentum encoders

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$$S_{VSL}^{xy} = \alpha S_{SLAVC}^{xy} + (1-\alpha) S_{OGL}^{xy}$$

Input **SLAVC** **OGL** **VSL** $(\alpha = 0.5)$

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3. DEMO

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A Closer Look at Weakly-Supervised Audio-Visual Source Localization demo

Article | Demo | Archive

Please cite the reference article if you publish results obtained with this online demo.

Description

Demo of the paper 'A Closer Look at Weakly-Supervised Audio-Visual Source Localization'.

Select input(s)

Upload data

Input(s)

Parameters

Restablecer

alpha 0,5 Max: 1 Min: 0

Level of importance of SLAVC with respect of OGL in VSL. VSL(x,y) = alpha * SLAVC(x,y) + (1 - alpha) * OGL(x,y)

Run

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3. DEMO

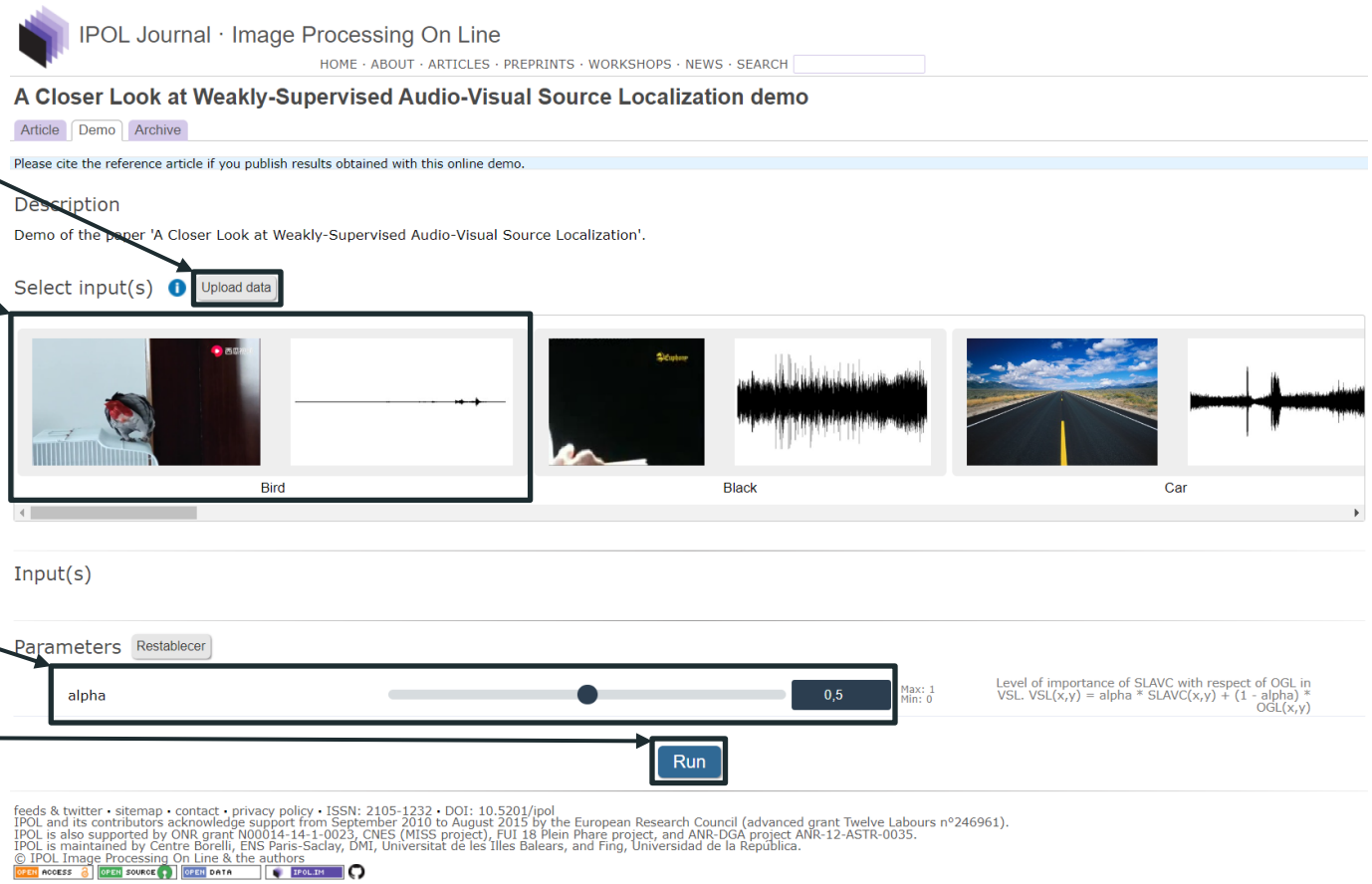
Upload image and audio file

Select pair of image audio from the ones provided

Select α value:

$$S_{VSL}^{xy} = \alpha \cdot S_{SLAVC}^{xy} + (1-\alpha) \cdot S_{OGL}^{xy}$$

Run the demo



3. DEMO

Results

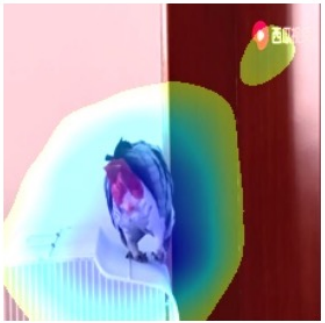
Input

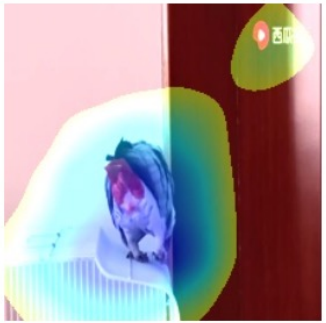
Simultaneous Localization and Audio-Visual Correspondence (SLAVC)

Object Guided Localization (OGL)

Visual Sound Localization (VSL)

☑ Compare





Input

Simultaneous Localization and Audio-Visual Correspondence (SLAVC)

Object Guided Localization (OGL)

Visual Sound Localization (VSL)

Zoom 1x

Colorbar

Zoom 1x

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4. EXPERIMENTS

1. Impact of α
2. Easy cases
3. Difficulties on Visual Sound Localization
   - 3.1 Mixture of sounds
   - 3.2 Small objects
   - 3.3 Silent objects
   - 3.4 Off-screen sounds
   - 3.5 Different objects of the same type

4. EXPERIMENTS

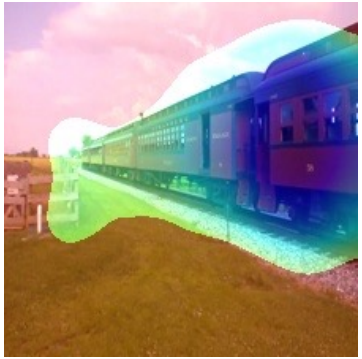
Impact of α

$$S_{VSL}^{xy} = \alpha S_{SLAVC}^{xy} + (1-\alpha) S_{OGL}^{xy}$$

Input

SLAVC

OGL



$\alpha = 0.10$

$\alpha = 0.25$

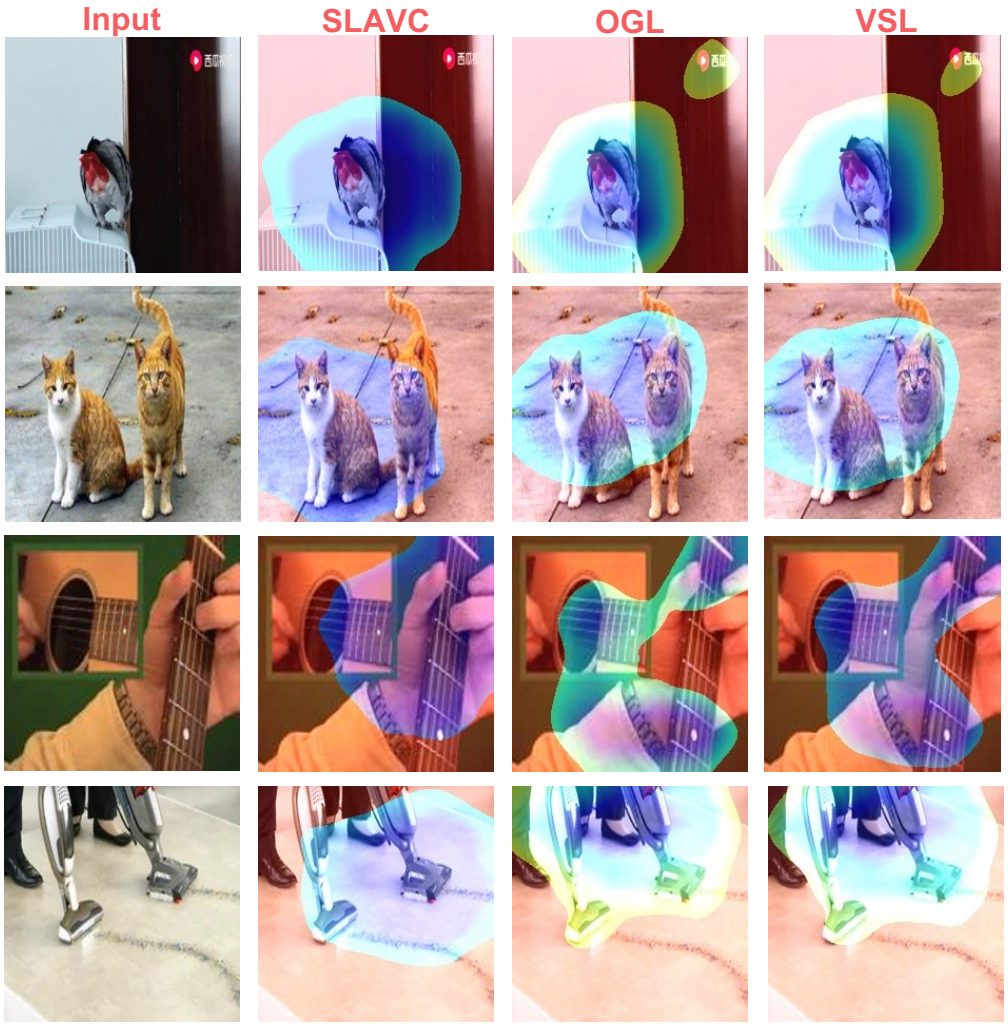
$\alpha = 0.50$

$\alpha = 0.75$

$\alpha = 0.90$

4. EXPERIMENTS

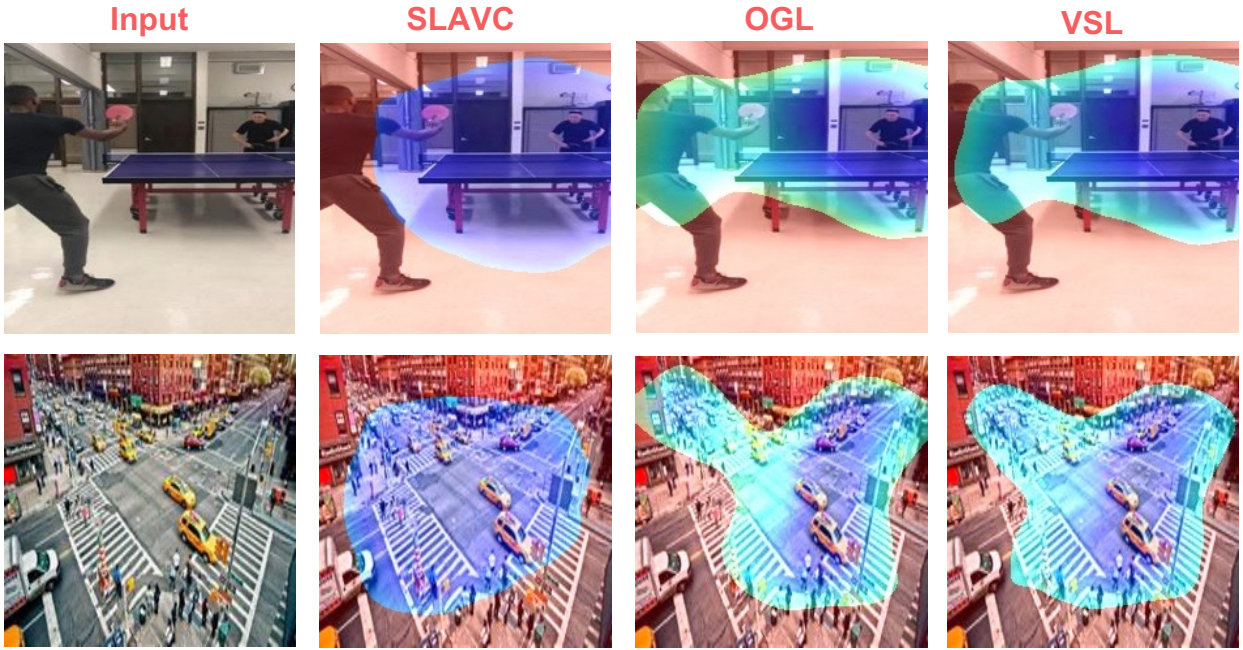
Easy cases



4. EXPERIMENTS

Difficult cases:

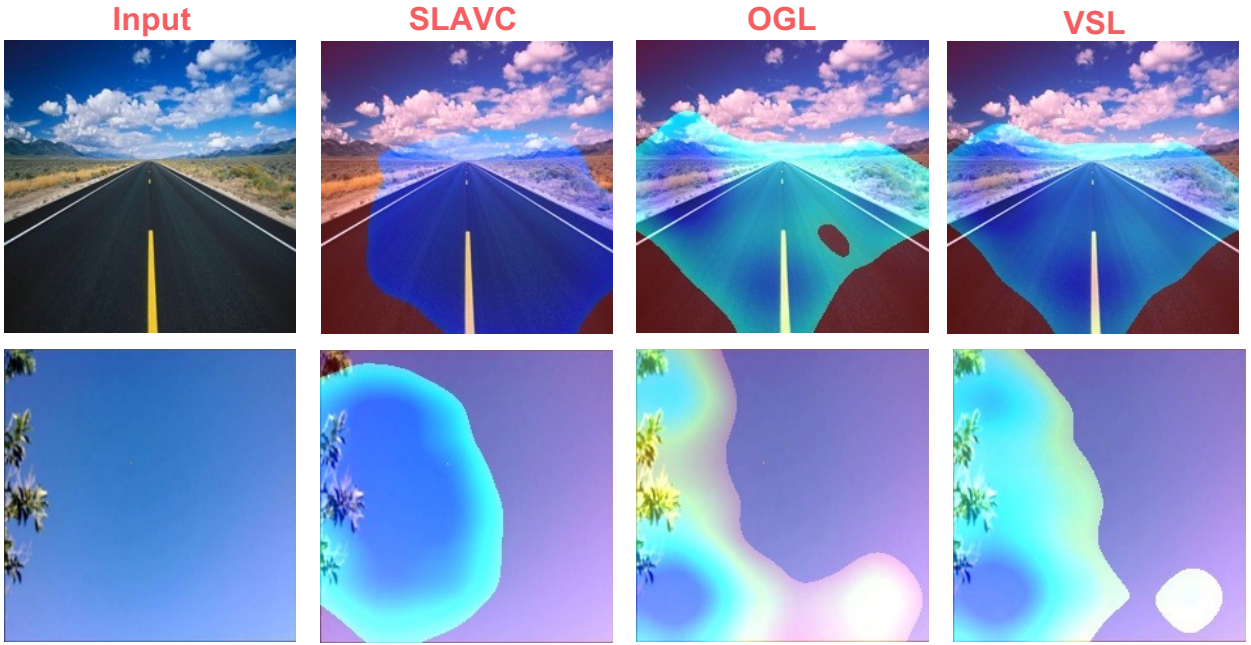
1. Mixture of sounds



4. EXPERIMENTS

Difficult cases:

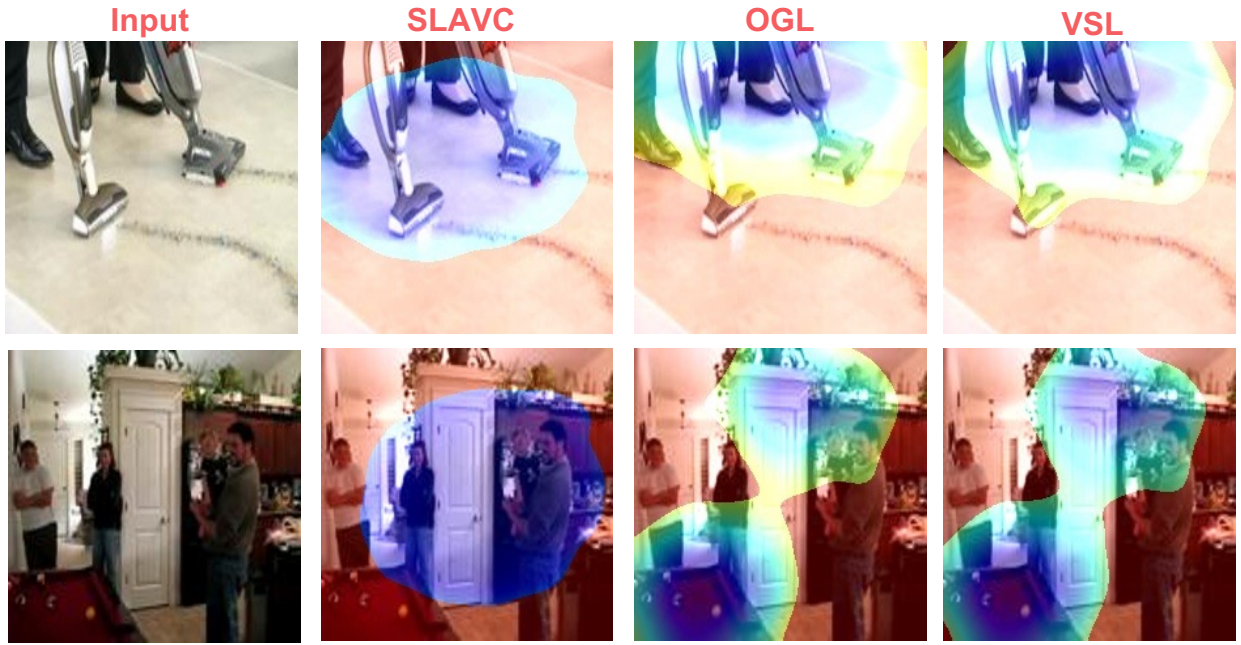
2. Small objects



4. EXPERIMENTS

Difficult cases:

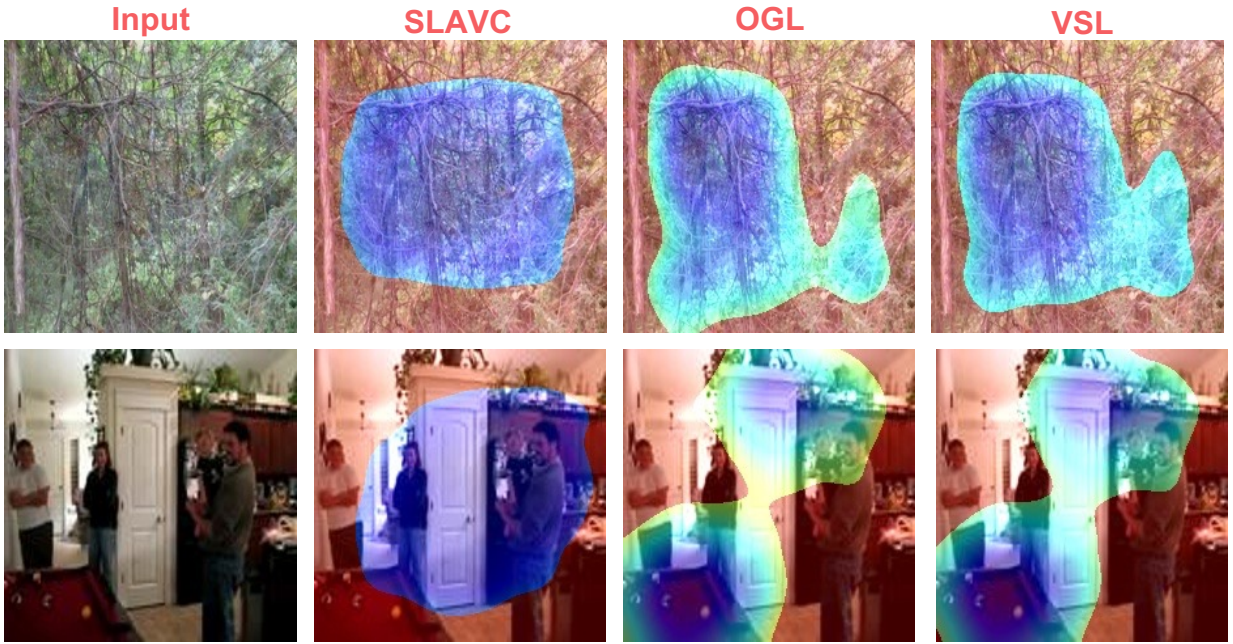
3. Silent objects



4. EXPERIMENTS

Difficult cases:

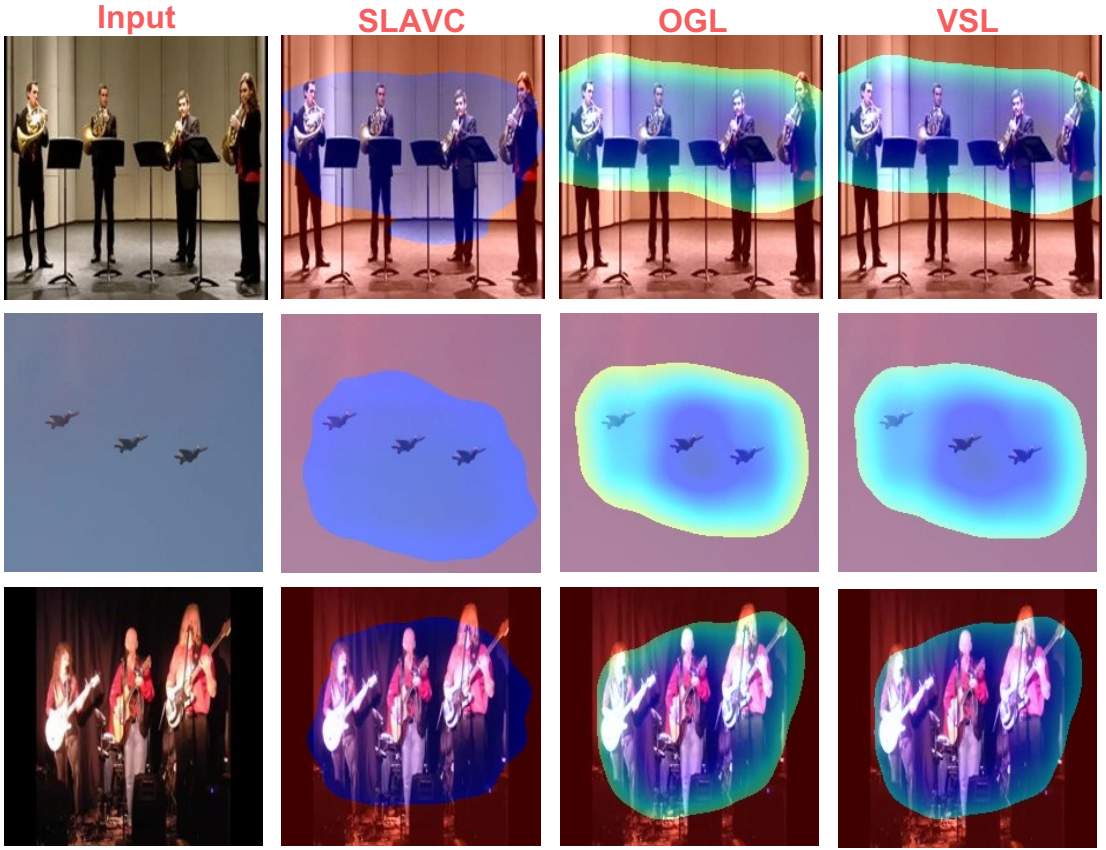
4. Off-screen sounds



4. EXPERIMENTS

Difficult cases:

5. Different objects of the same type



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5. PROPOSED IMPROVEMENTS

- ✓ Good results on many cases
- ✗ Mixture of sounds
- ✗ Small objects
- ✗ Silent objects
- ✗ Off-screen sounds
- ✗ Different objects of the same type

1. Image → Videos → Learn motion cues
2. Audio and Visual prototypes used to define proper filters to be applied in the localization map (Liu et al. [8]

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Questions?