CO-RECOGNITION FOR IMAGE AND VIDEO ANALYSIS

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Abstract

For unsupervised visual analysis of object patterns, we pose a 'co-recognition' problem of detecting and segmenting all the object-level region correspondences by considering geometric relations of visual patterns. To solve it, a multi-layer match-growing framework is proposed which explores given visual data by intra-layer expansion and inter-layer merge. It applied to solve several vision problems such as identical object detection, image retrieval, symmetry detection, and action recognition.

Introduction

- Conventional recognition settings with supervisions

Model   Test

- How to achieve a **fully unsupervised** object-level pattern discovery?

* Recent trends in object categorization:
  Statistical topic discovery by **exploring a large amount of images**

Fergus et al. ICCV2005   Lee and Grauman. CVPR2009

* Our approach from another extreme:
  Pattern discovery by **thoroughly exploring a small amount of images**

- **'Co-Recognition'** problem
  Unsupervised detection & segmentation of **object-level** region correspondences from given images by considering **geometric relations** of visual patterns


- Related works

Co-Segmentation (Rother et al. CVPR06),
Co-Saliency matching (Toshev et al. CVPR07),
Common Pattern Discovery (Yuan et al. ICCV07)
reduce to subproblems of co-recognition.

Key Idea

- Use initial local region matches as seeds (distracting outliers and insufficient inliers)
- Augment them by simultaneously
  Growing (Expand/Contract) into photometrically compatible neighbors
  Ferrari et al., ECCV04, IJCV06
  Clustering (Merge/Split) geometrically compatible matches
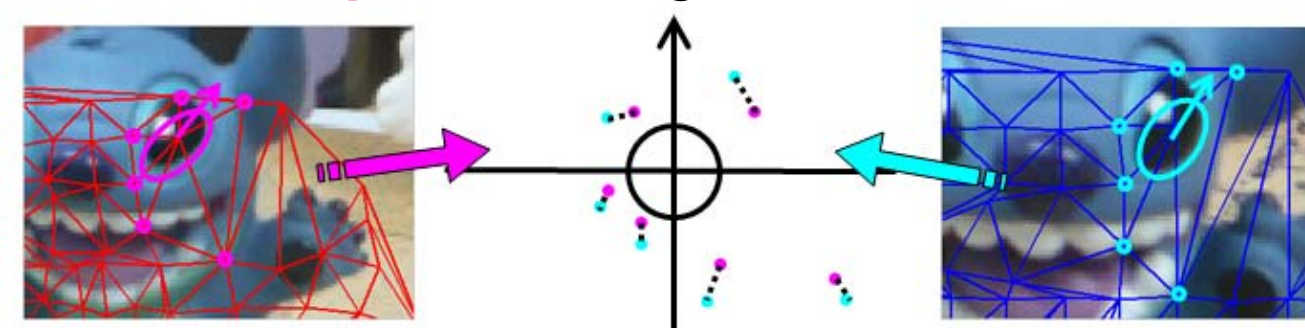 in a **Multi-layered Bayesian** framework
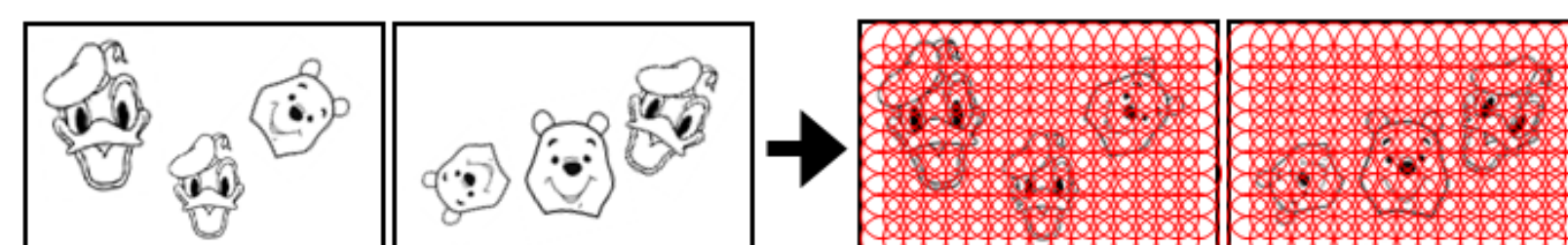
Each initial match has an expansion layer of overlapping regions

Intra-layer expansion

Inter-layer merge
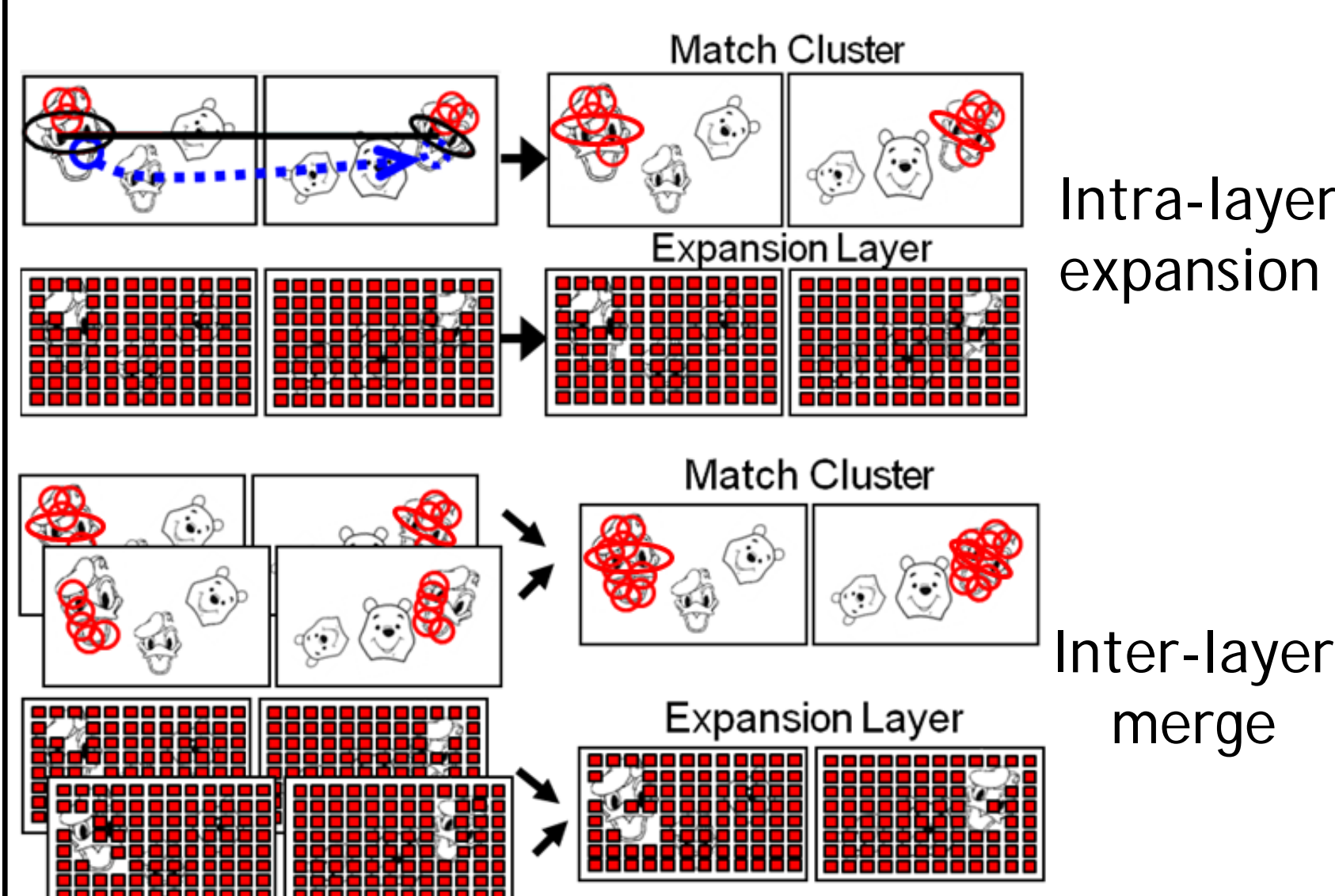
Proposed Algorithm

- Bayesian energy formulation consisting of
  1. **Maximality prior** for expansion and merge
  2. **Geometric prior** for geometric consistency

  3. **Photometric likelihood** for photo- similarity
- Inference by a stochastic algorithm based on a Data-Driven Monte Carlo framework
  (Illustration of a case given two images)

(a) Initial Matching
(b) Multi-layer Growing
(c) Expansion / Merge
(d) Pattern Analysis
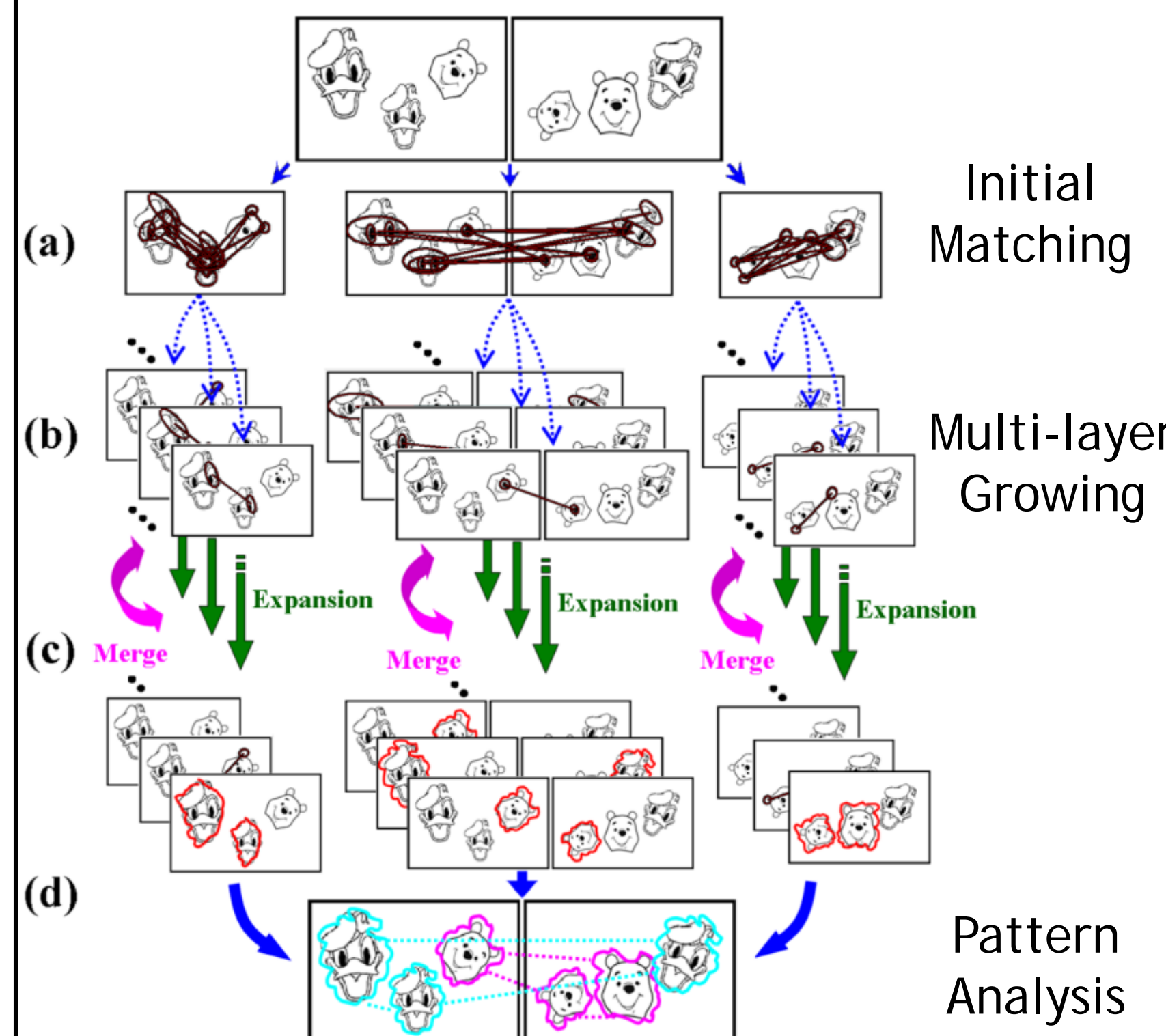
Applications

- ### Identical Object Detection (CVPR 2010)

- ### Image Retrieval (ECCV 2008)
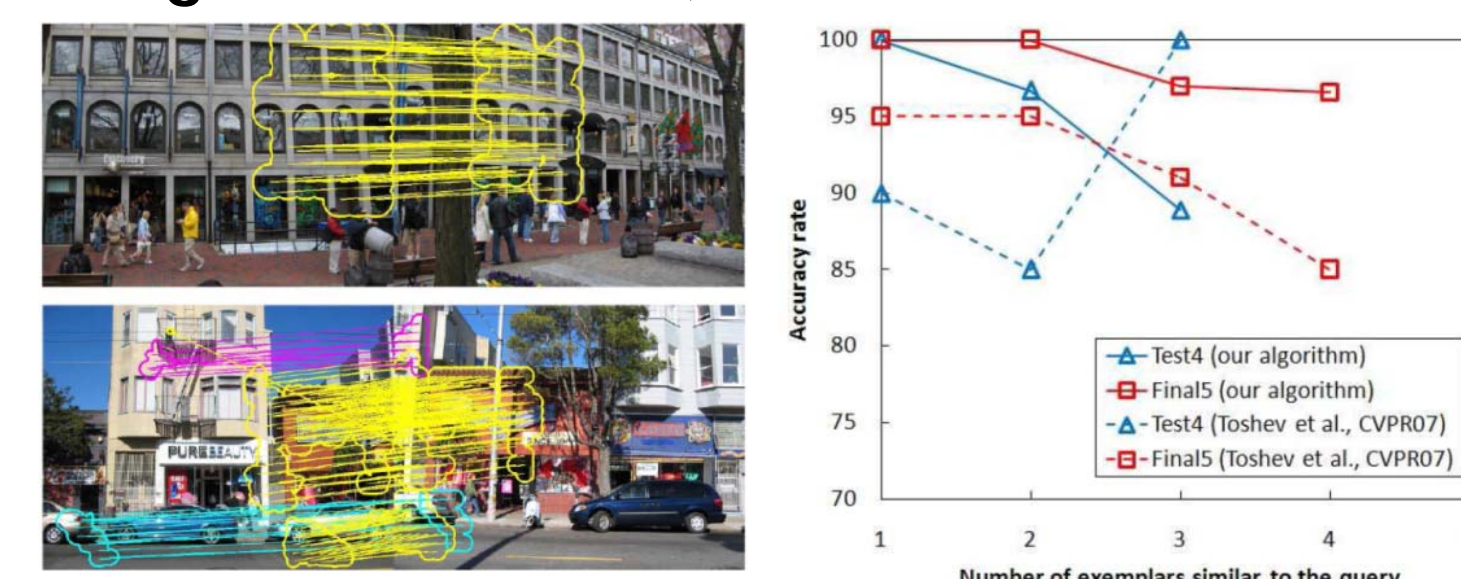
Image retrieval on ICCV2005 dataset

- ### Symmetry Detection (BMVC 2009)

Image Type	Synthetic Single			Synthetic Multiple		
Algorithm	LE06	LHS05	Ours	LE06	LHS05	Ours
S_0	92%	62%	**100%**	35%	28%	**77%**
R_{FP}	15%	0%	**15%**	4%	8%	**33%**
Image Type	Real Single			Real Multiple		
Algorithm	LE06	LHS05	Ours	LE06	LHS05	Ours
S_0	84%	29%	**94%**	43%	18%	**68%**
R_{FP}	68%	3%	**69%**	44%	0%	**17%**

Input   Our result
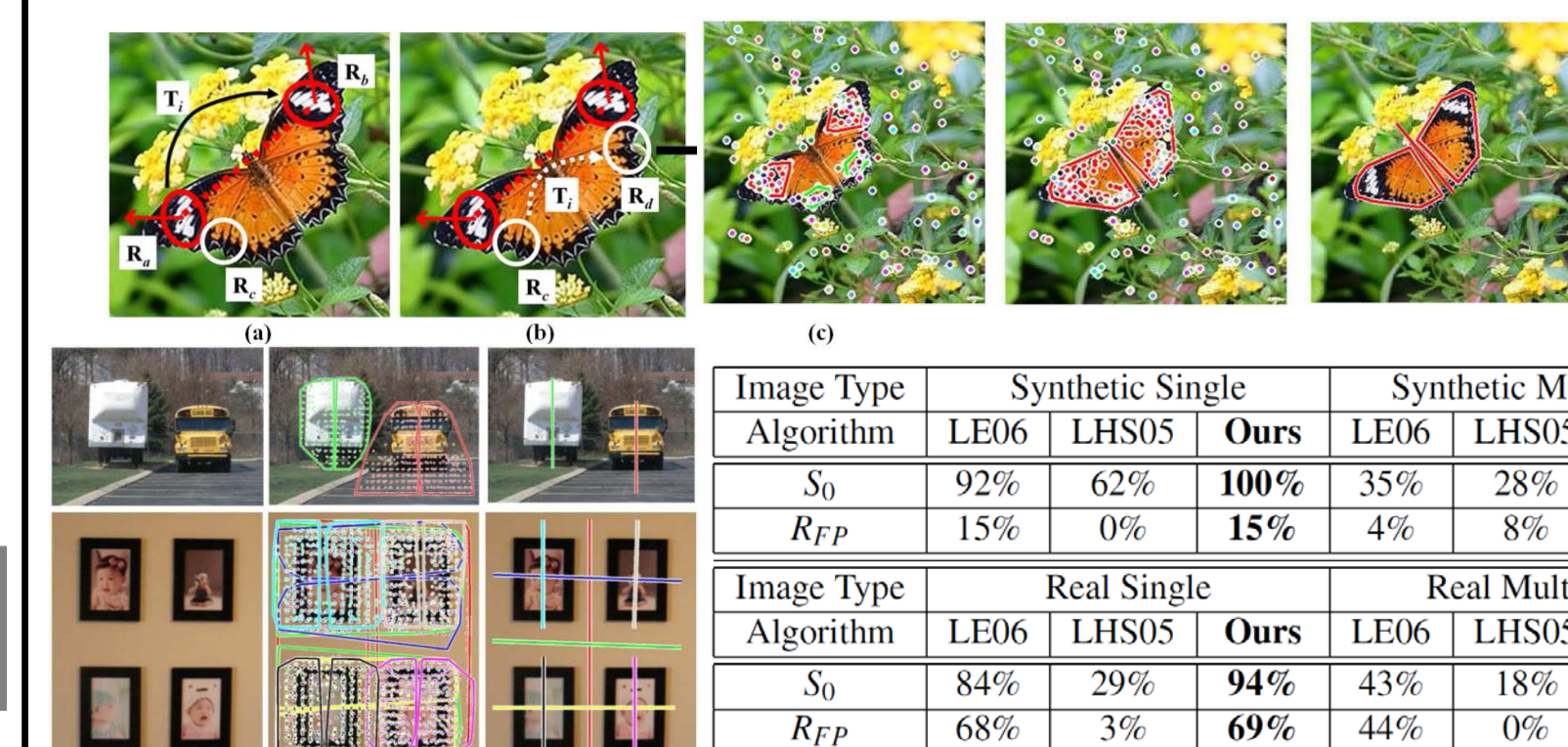
- ### Action Matching in Video Pairs (ICPR 2010)

	classification accuracy
Co-recognition	92.4%
Boiman et al. [7]	97.5%
Jhuang et al. [13]	93.8%
Filipovych et al. [11]	88.9%
Niebles et al. [12]	72.8%
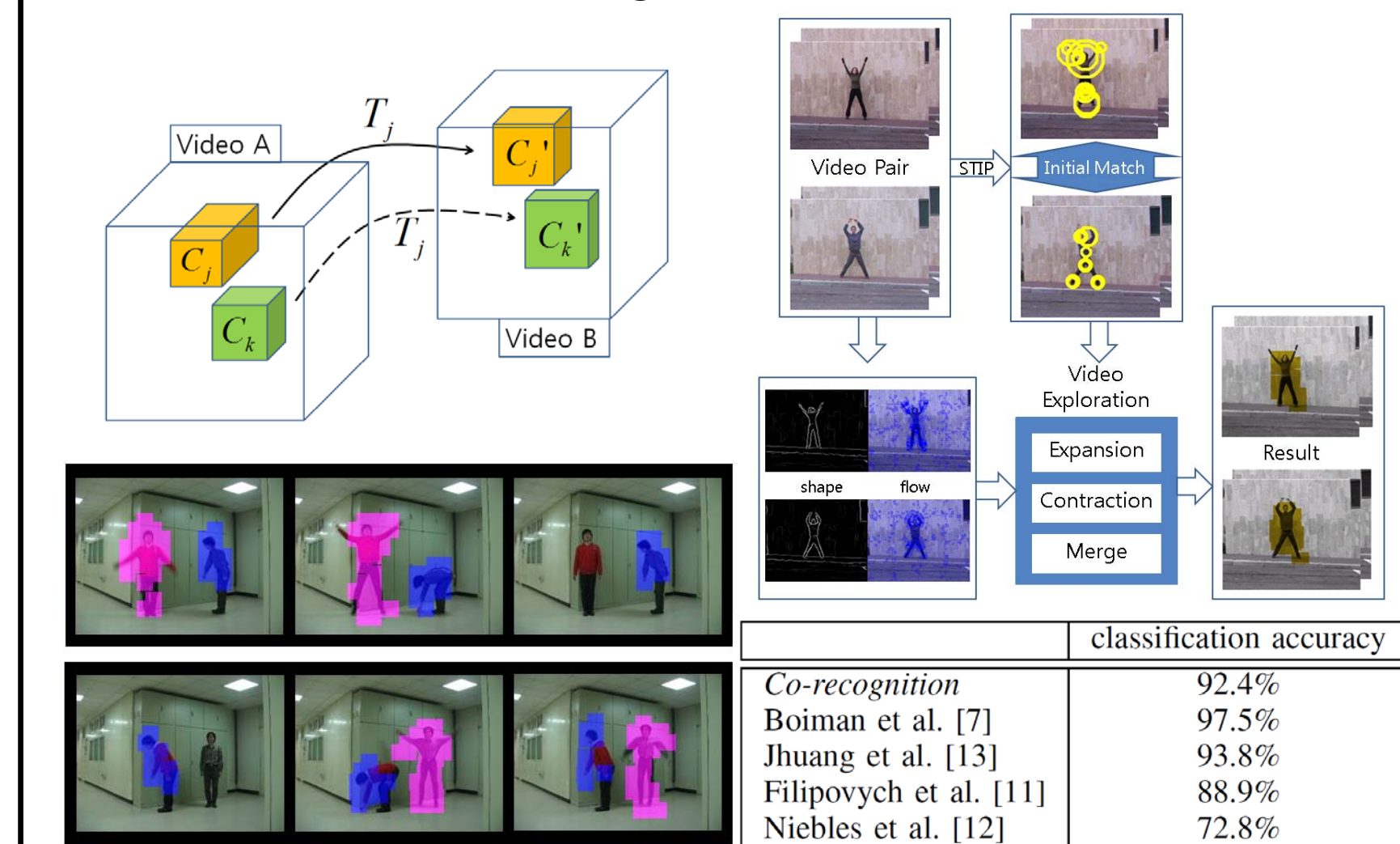
Discussion

- Many-to-many object matching across images
- Potential applications for various vision problems
- Failures in similar backgrounds due to ambiguity

References

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