August 1, 2016

Predicating What and Where in Social Media Images

SAN DIEGO STATE UNIVERSITY

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Department of Computer Science
San Diego State University (SDSU)

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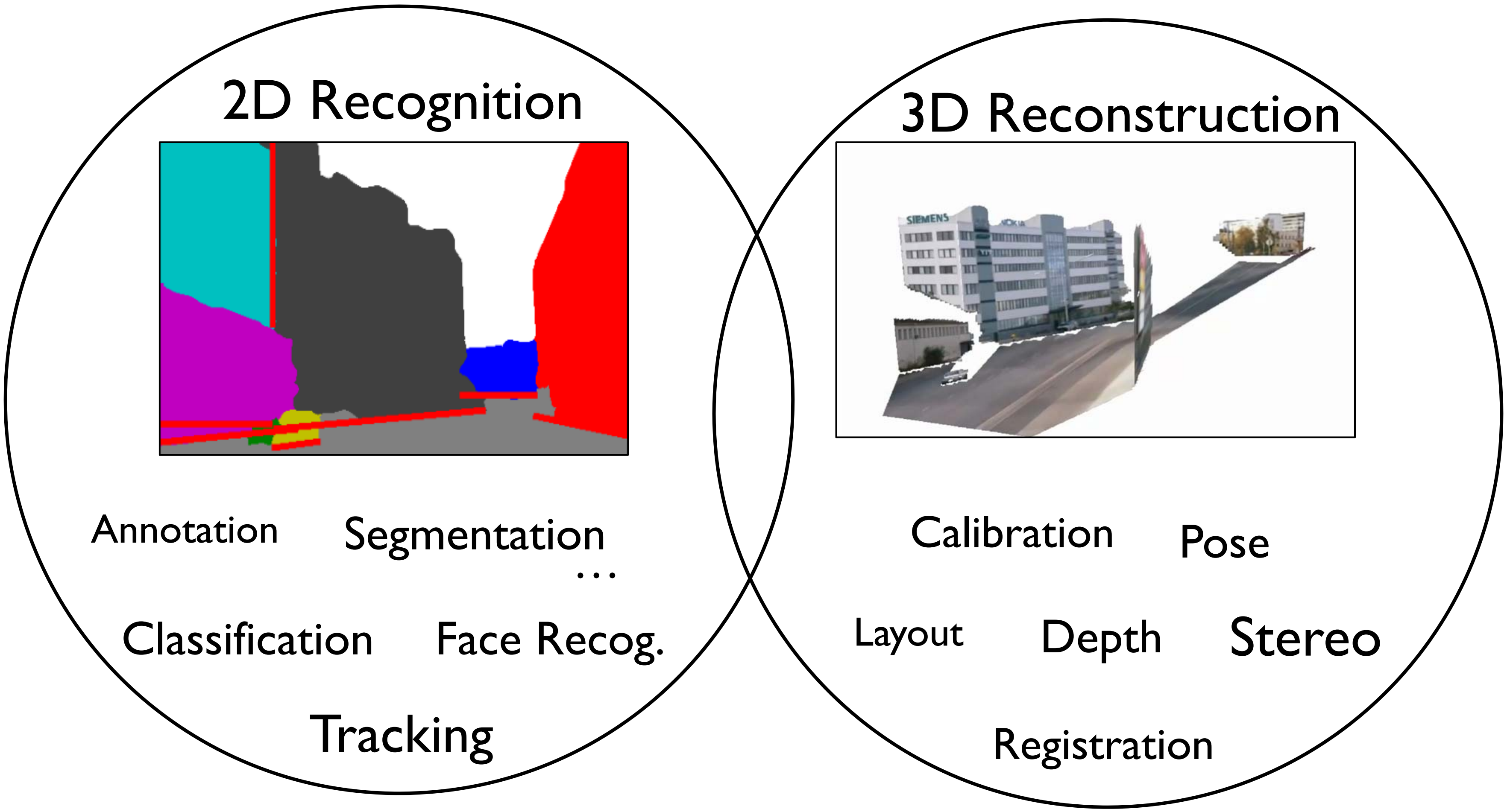
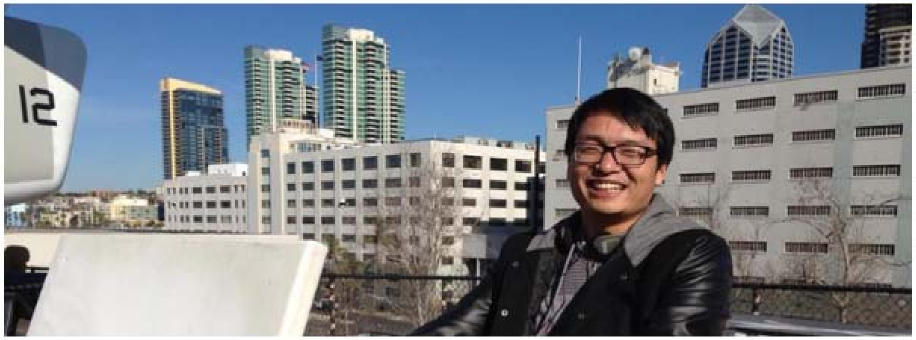
Computer Vision: What and Where

Computer Vision: What and Where



HTTP:// CV.SDSU.EDU

Liu Xiaobai , PhD



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News

July 22, 2016: Our paper on large-scale optimization will appear in the Journal TKDE (IF: 2.067).
July 10, 2016: Our paper on video coding will appear in the Journal FGCS (IF: 2.054).
June 25, 2016: I will chair the session: Maching Learning 8- Data Mining in IJCAI'2016. Welcome to Attend!
June 22, 2016: Our paper on Visual Vehicle-to-Vehicle (V3I) was accepted as Oral Presentation by ACM MM'2016
Apr. 10, 2016: Our paper on Hierarchical LSTM model for Scene Parsing was accepted by IJCAI'2016.
Apr. 10, 2016: Our paper on Mobile Landmark Search was accepted by IJCAI'2016.
Apr. 10, 2016: Our paper on Single-view 3D Scene Reconstruction was accepted by IJCAI'2016.
Feb. 29, 2016: Our Paper on Multi-view Human Tracking was accepted by IEEE CVPR'2016!
Feb. 24, 2016: Received the SDSU GREW Fellowship Spring 2016.
Feb. 1, 2016: I will chair the sessions of VIS: Pose Estimation and ML: Deep Learning I in AAAI' 2016. Welcome to Attend!
Jan. 10, 2016: Our Proposal to the SDSU Undergraduate Research Program has been awarded. Congradulations to Jacob Thalman!
Jan. 7, 2016: Received a donation of GPU K40 from the NVIDA Inc. Thanks NVIDA!
Dec. 1, 2015: Our paper on Attributed Grammar was accepted by AAAI' 2016.

Biography

I am working as Assistant Professor of Computer Science at the San Diego State University (SDSU) . I am also affiliated with the Center for Vision, Cognition, Learning and Autonomy (VCLA), University of Californiat, Los Angeles (UCLA).
In prior to joining SDSU, I worked as a Postdoctoral Research Scholar at the University of California, Los Angeles (UCLA) with Professor Song-Chun Zhu (from July 2013 to August 2015) and Professor Alan L. Yuille (from June 2011 to July 2013). I received my PhD degree from the Huazhong University of Science and Technology (HUST) in November, 2012. I was a visiting Doctoral Student at the National University of Singapore (NUS), Singapore, working Professor Shuicheng Yan from 2008-2011.

Teaching

Computer Vision & Machine Learning

Outline of this Talk

- **Part –I: 2D reconstruction (What)**
  (weakly supervised image parsing)
  - Label-to-Region
  - Label-to-region by search
  - Image Label Competition
  - Tree-structure sparsity
- **Part-II: 3D reconstruction (Where)**
  - Single-image Reconstruction (demo 1-3)
  - 3D Human tracking (demo 4-6)

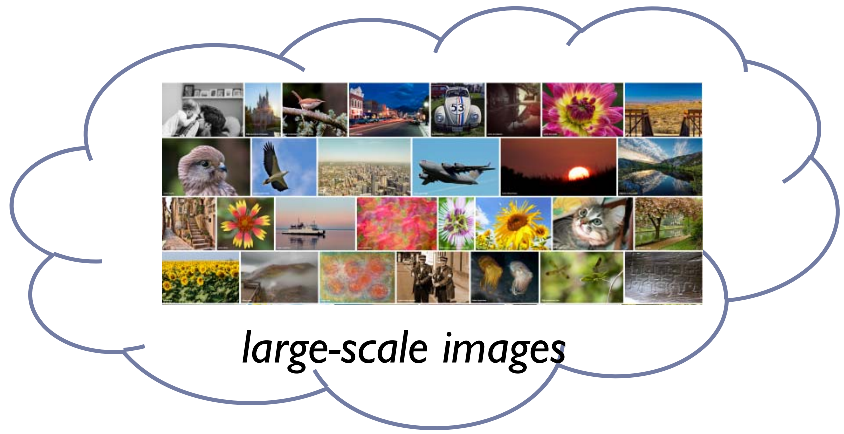
Nominated as one of two Best Paper Candidates in Content Track

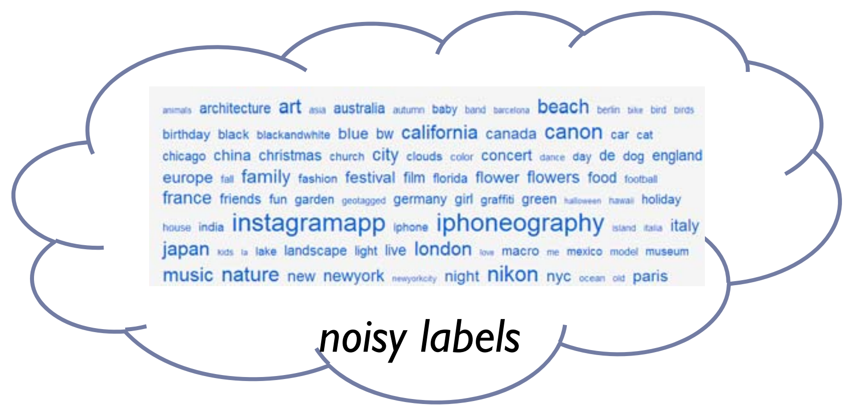
I. Label to Region by Bi-Layer Sparsity Priors

- **X. Liu**, B. Cheng, S. Yan, T. Chua, J. Tang and H. Jin., **Label to Region by Bi-Layer Sparsity Priors**. Proc. *ACM Conference on Multimedia* (***MM,*** Full Paper), 2009

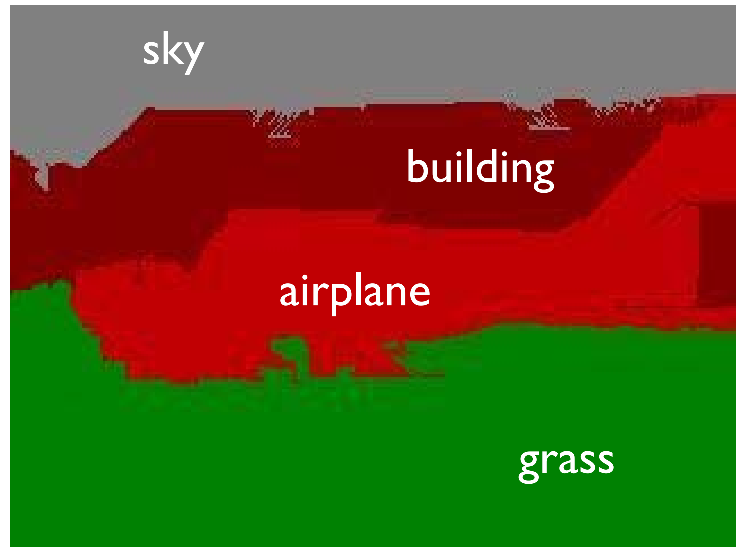
Online Photos

- Photo-sharing websites
  - ✓ Twitter
  - ✓ Flickr
  - ✓ Facebook
  - ✓ eBay
  - ✓ …
- Potentials
  - Content-based image retrieval
  - Visual Recommendation
  - Dr. Tsou's homepage



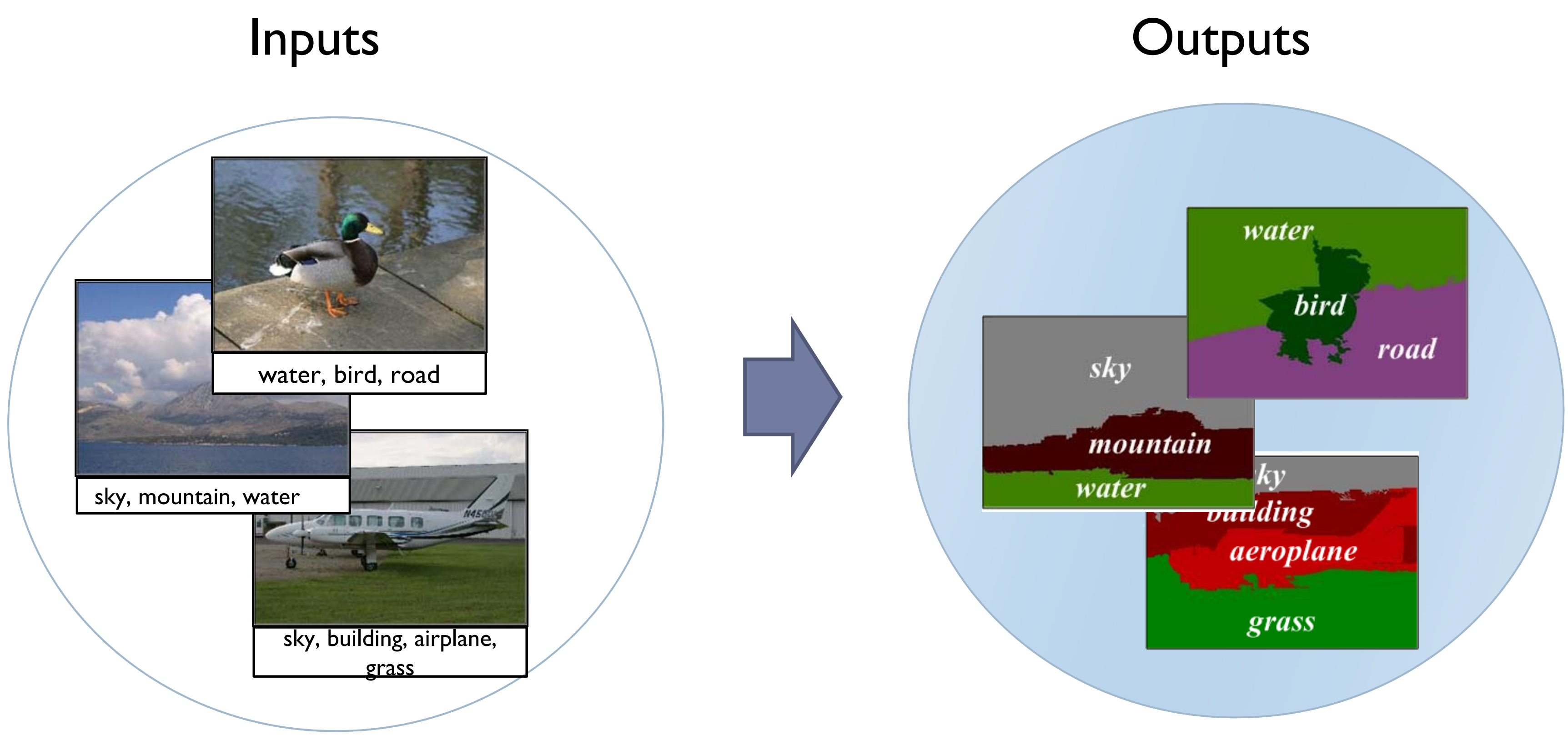


Task: Label to Region



Label to Region for a single Image is Challenging!

Task: Label to Region

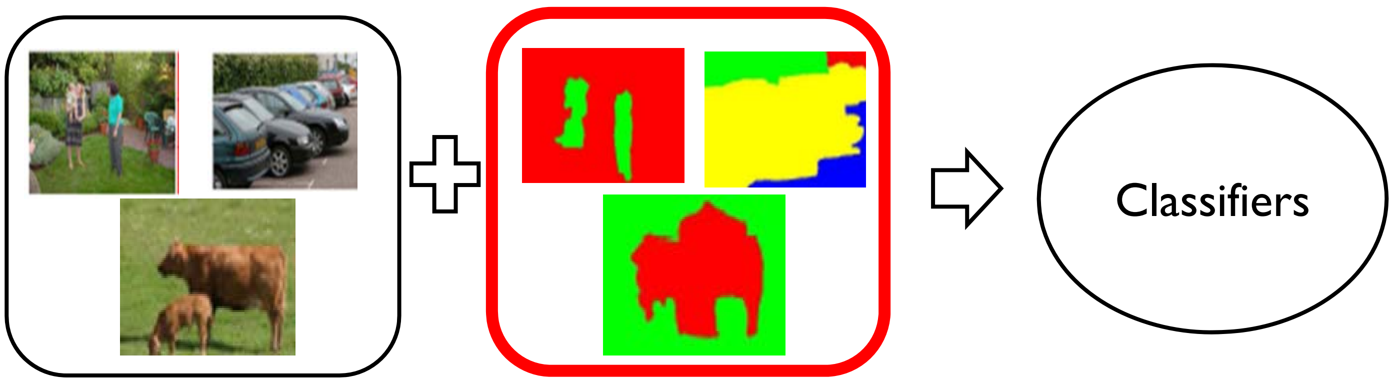


Simultaneous Region Partition and Labeling in Batch Mode

Related Work

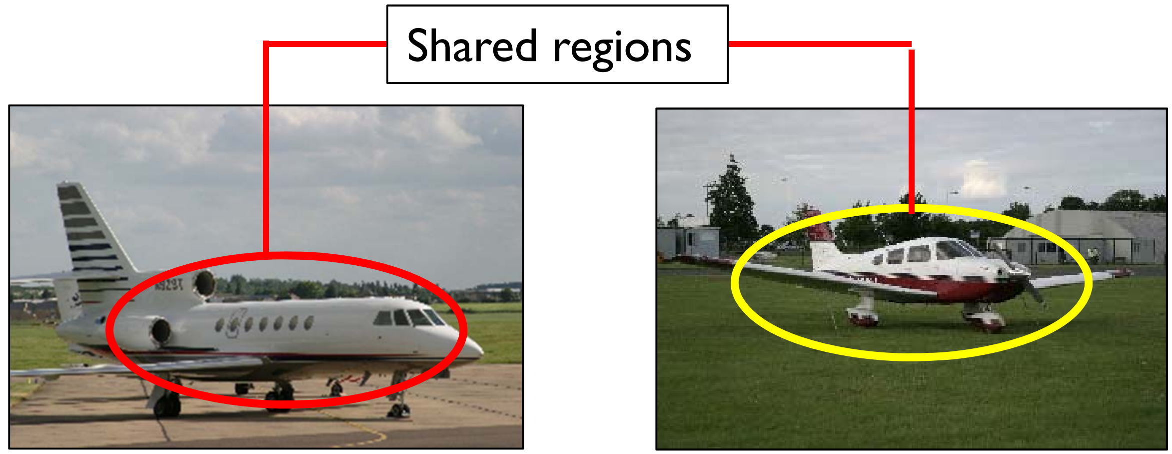
Supervised Learning Techniques

[C.Galleguillos et al., 2008][Jeon et al., 2003][Kang et al., 2006][Zhang et al., 2007]



Label-to-Region is valuable in Computer Vision community.

Label to Region: Our Approach



sky, road, aeroplane

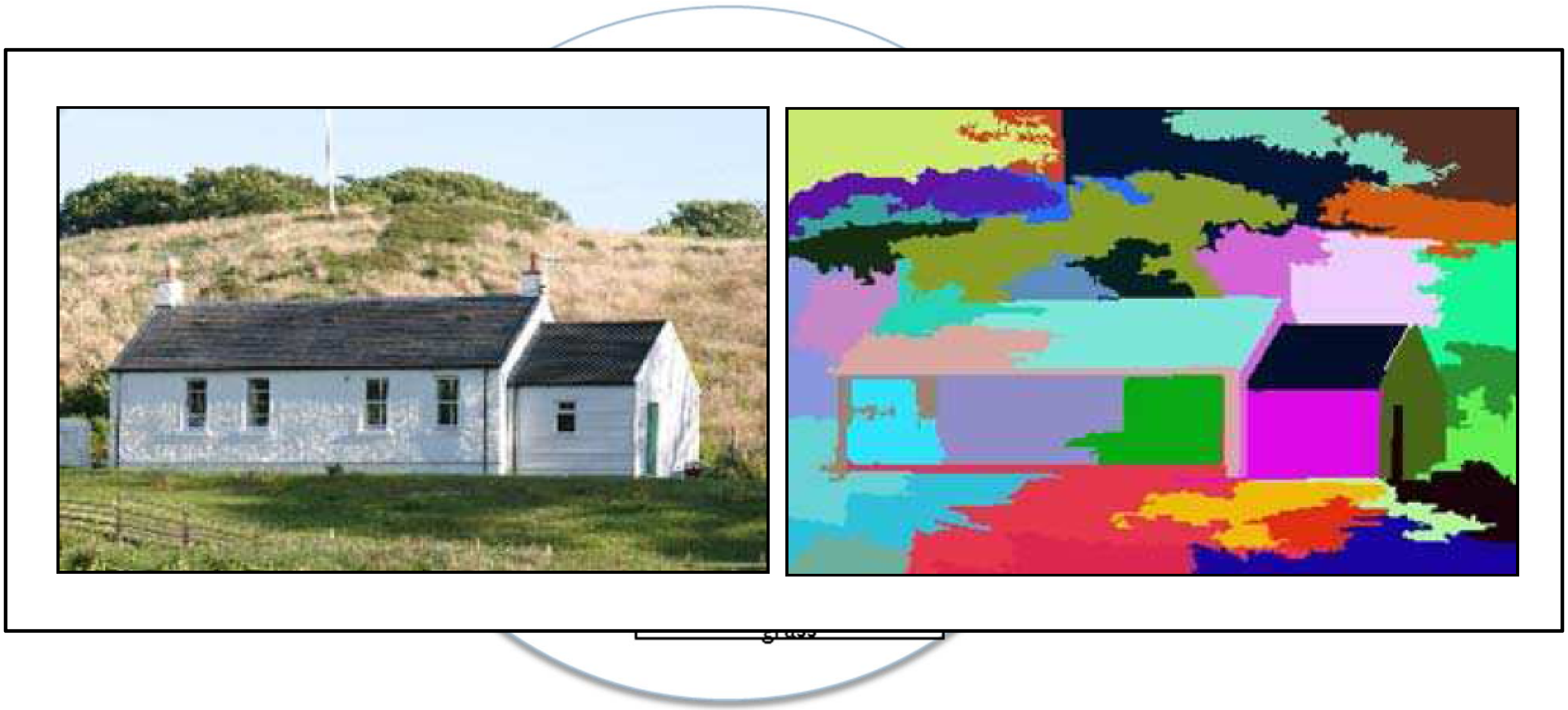
sky, grass, tree, aeroplane

Solution: for each pair of images, assign shared labels, if any, to shared regions!

Cross-Image Correspondence

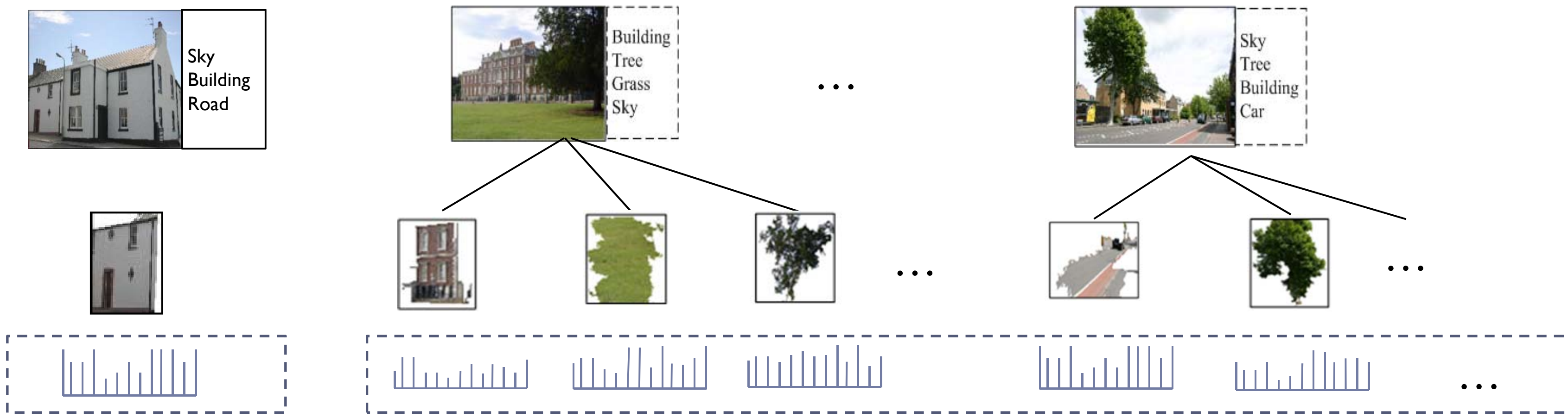
Label to Region: Correspondence

Step-1: Over-Segmentation



Label to Region: Our Approach

Step-2: cross-image correspondence



$$y = A_1\boxed{\alpha_1} + A_2\boxed{\alpha_2} + A_3\boxed{\alpha_3} + \cdots \quad A_4\boxed{\alpha_4} + \cdots$$

Using Coefficients as Relevance

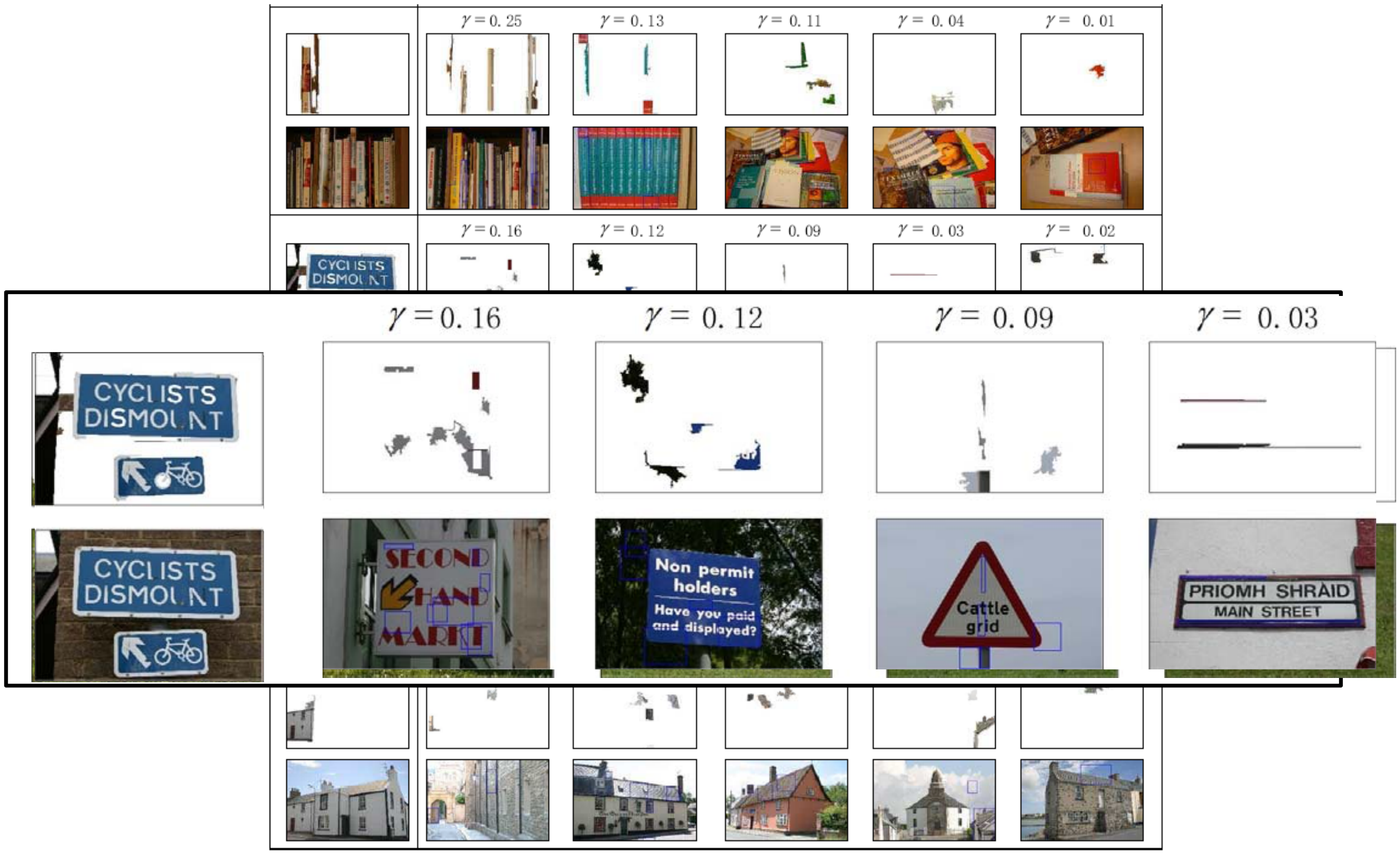
Criteria:

- *Select as few patches as possible;*
- *Select patches from as few images as possible:*

$$\arg\min_{\alpha,\epsilon,\gamma} ||\alpha||_1 + ||\epsilon||_1 + ||\gamma||_1 \quad s.t. \quad y = A\alpha + \epsilon,\ \gamma = B\alpha$$

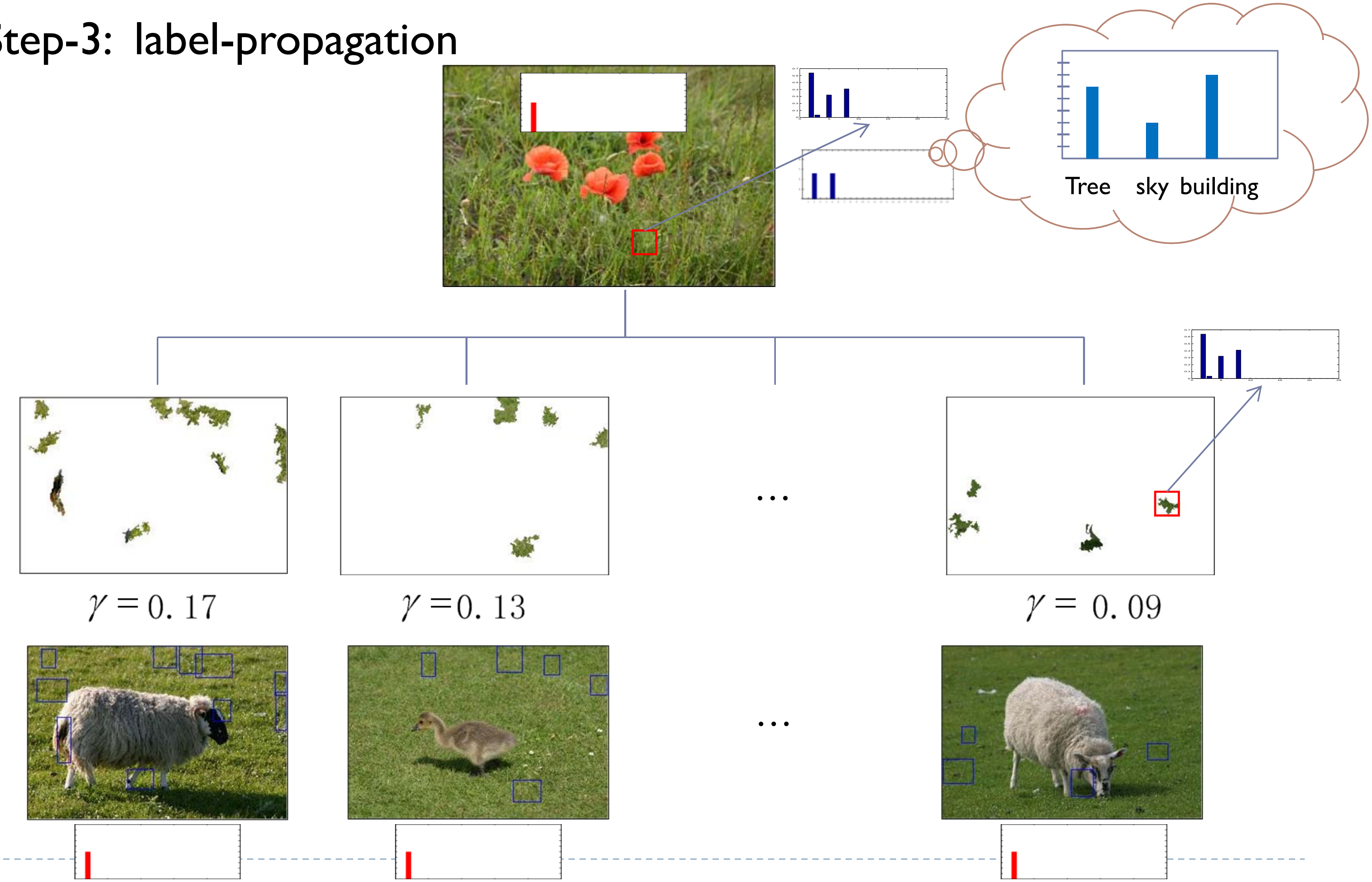
Bi-Layer Sparse Representation

Label to Region: correspondence

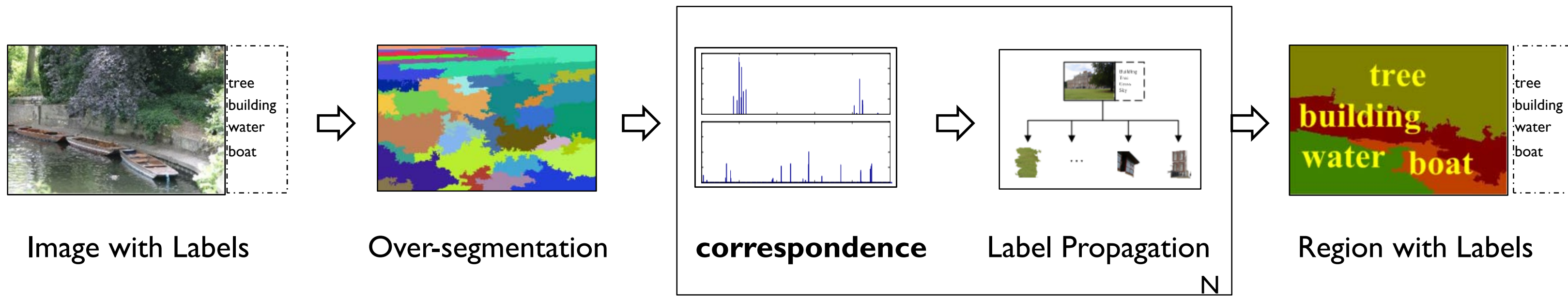


Label to Region： Label Assignment

Step-3: label-propagation



Label to Region: Our Approach



Step 1: ***Initialization***

- Over-segmentation

Step 2: Select one of the input images as reference image

Step 2.1: recover cross-image correspondence: bi-layer sparse representation

Step 2.2: bi-directional *label propagation*

Step 3: ***Post-Processing***

- Derive semantic regions and associated labels.

Label to Region: Results

MSRC dataset

Label to Region：Accuracies

Dataset	SVM-1	SVM-2	SVM-3	SVM-4	One-Layer	Bi-Layer
MSRC	0.22	0.20	0.24	0.23	0.47	0.63 0.81
COREL	0.29	0.32	0.33	0.32	0.51	0.61 0.76

The SVM-based algorithm is implemented with different values for the parameter of maximal patch size, namely, SVM-1: 150 pixels, SVM-2: 200 pixels, SVM-3: 400 pixels, and SVM-4: 600 pixels.

Summary of Label-to-Region

Contributions

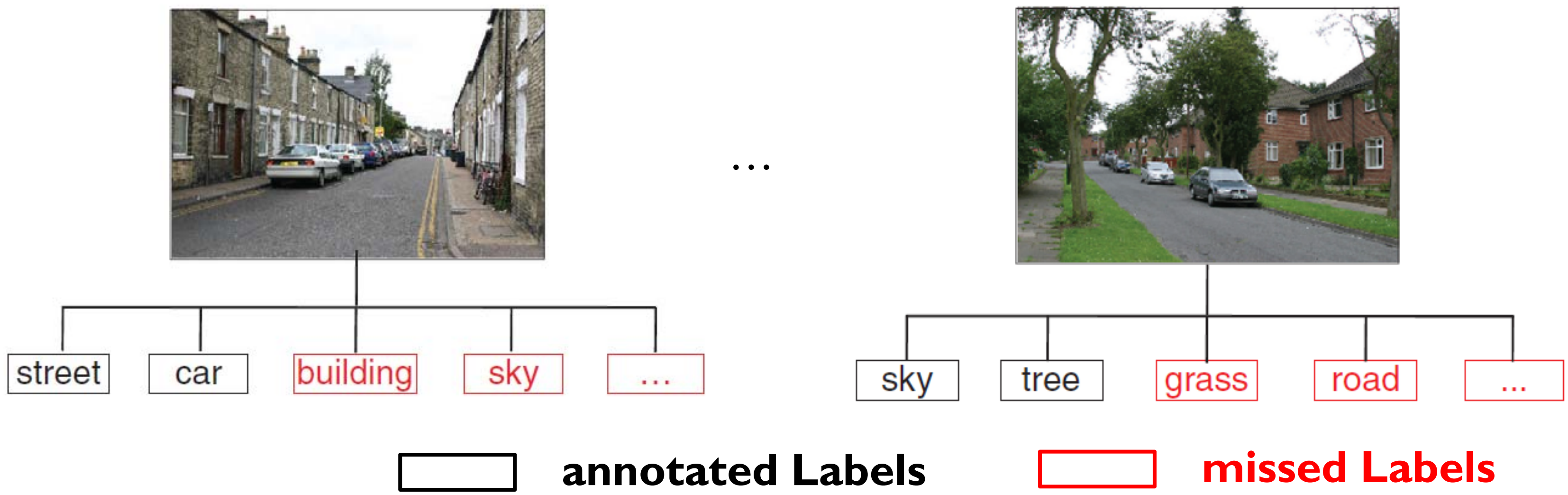
- Label-to-Region task
- Label propagation
- Bi-Layer sparsity Model

Limitations

- Can only handle labels corresponds with local region, e.g. , road;
- Process a set of images at the same time;
- Cannot handle partially annotated images or noisy tags;

II. Image Label Completion

Partially annotations or noisy labels

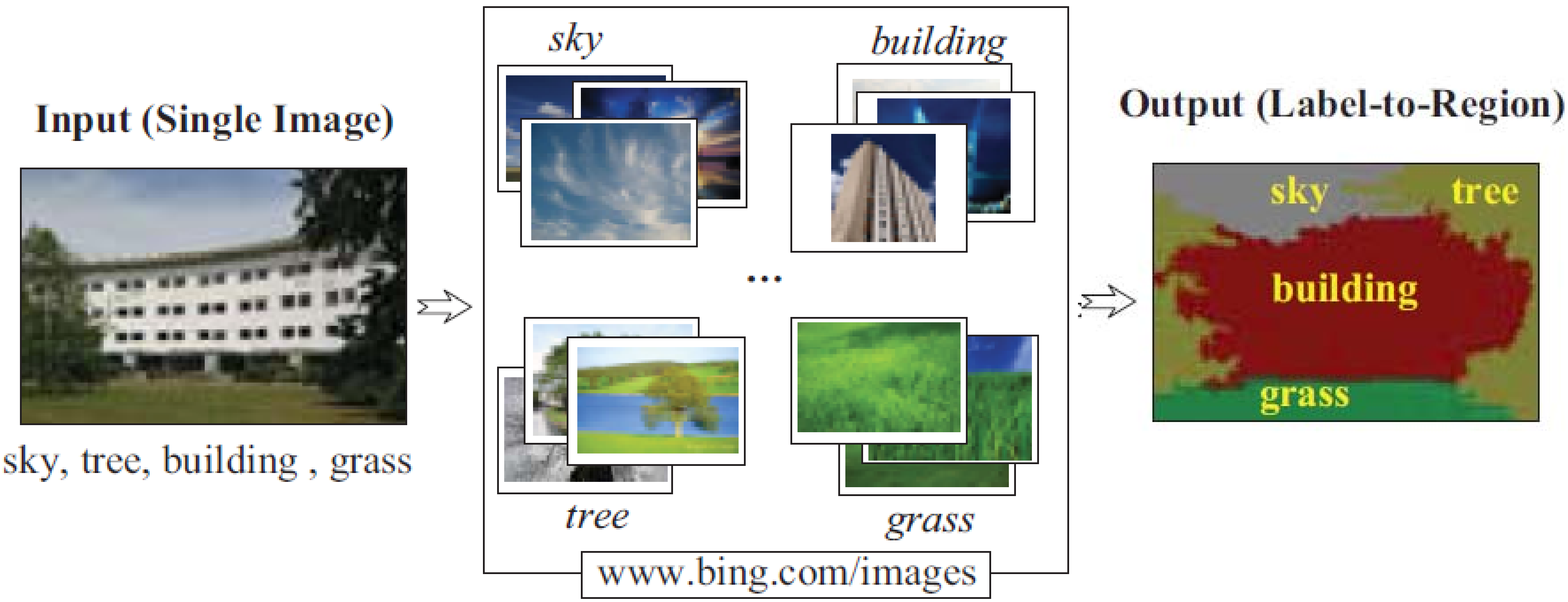


Label Completion via Nonnegative Decomposition

$$\min_{W,Y} \alpha Tr(WBW^T) + \beta Tr(CYLY^TC^T) + \gamma ||\tilde{Z}_0 \circ (CY)||^2 + ||X - WY||^2, \quad s.t.\ W, Y \geq 0,$$

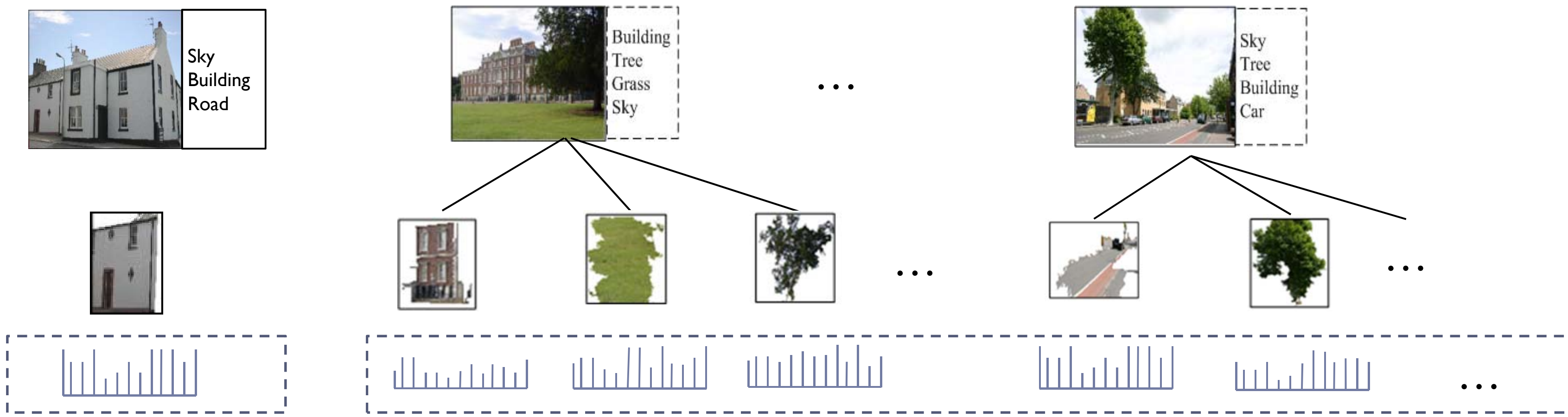
X. Liu, et al. IEEE Transactions on Image Processing, 2010

III. Label-to-region by Search



[Liu et al. IEEE CVPR'2010]

IV. Tree Structure Sparsity



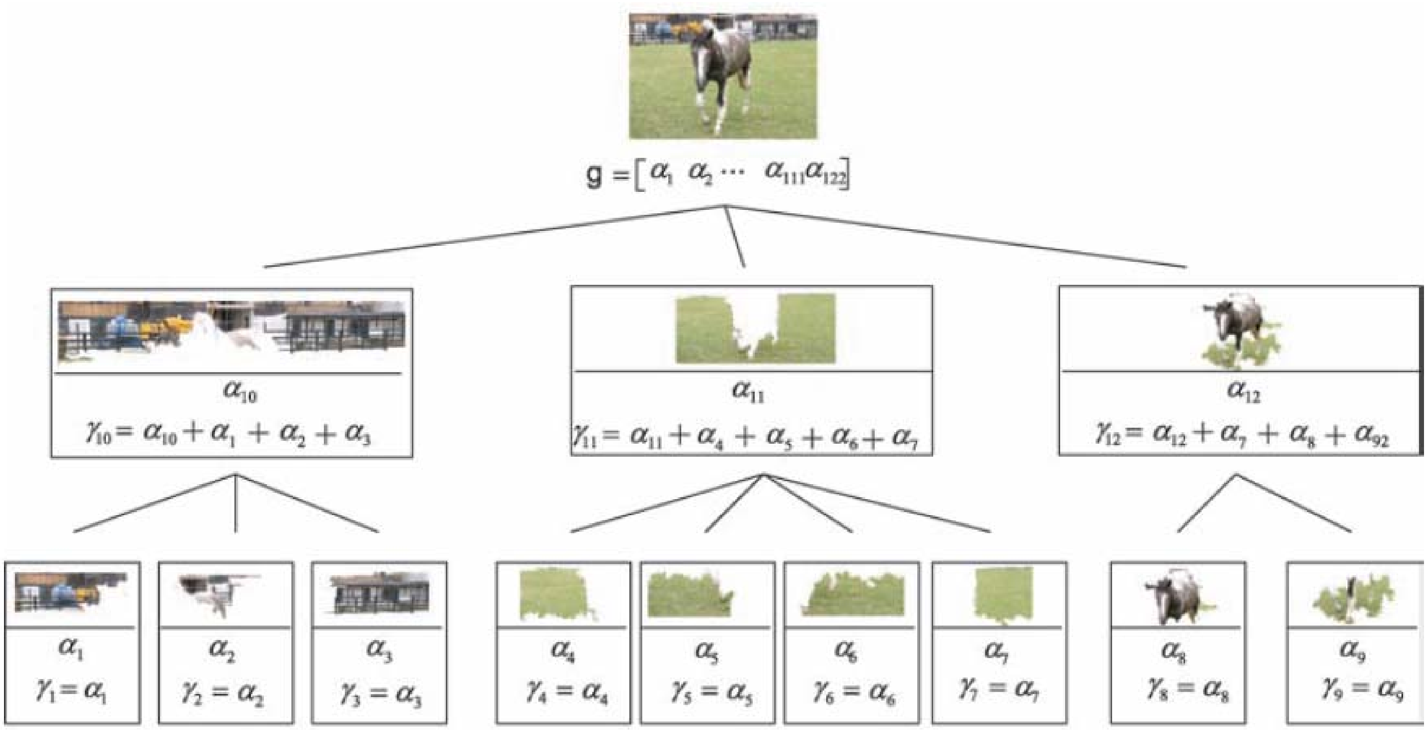
$$y = A_1\alpha_1 + A_2\alpha_2 + A_3\alpha_3 + \cdots \quad A_4\alpha_4 + \ldots$$

$$\arg\min_{\alpha,\epsilon,\gamma} ||\alpha||_1 + ||\epsilon||_1 + ||\gamma||_1 \quad s.t. \quad y = A\alpha + \epsilon,\ \gamma = B\alpha$$

Bi-Layer Sparse representation

[**X. Liu**, ACM Transaction on MCCAP 2012]

IV. Tree Structure Sparsity



From Bi-Layer to Tree Structure

[X. Liu, ACM Transaction MCCAP 2012]

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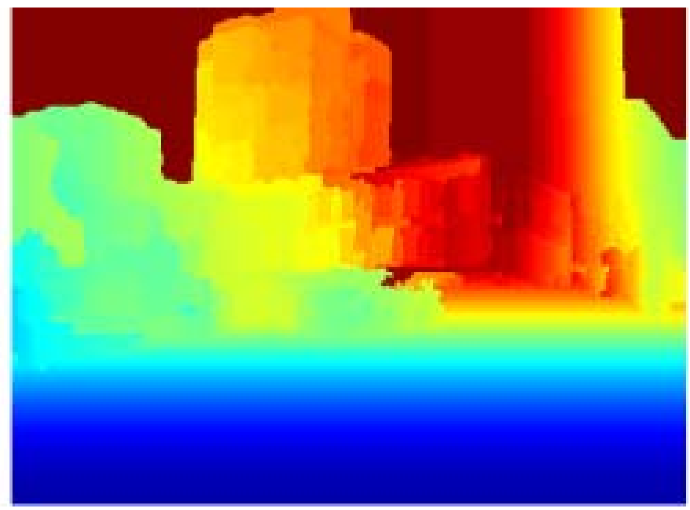
Demo 1: 3D Scene Reconstruction from a single image

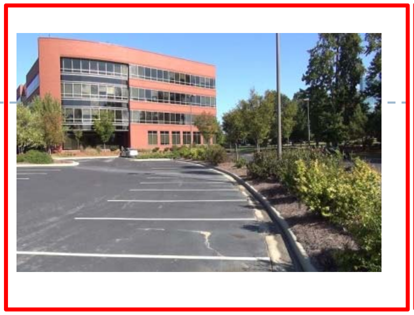
[Liu et al. CVPR'2014], [Liu et al. AAAI'2016], [Liu IJCAI'2016]

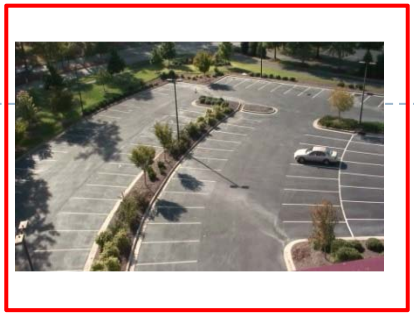
Demo 1: 3D Scene Reconstruction from a single image

Demo 1: 3D Scene Reconstruction from a single image

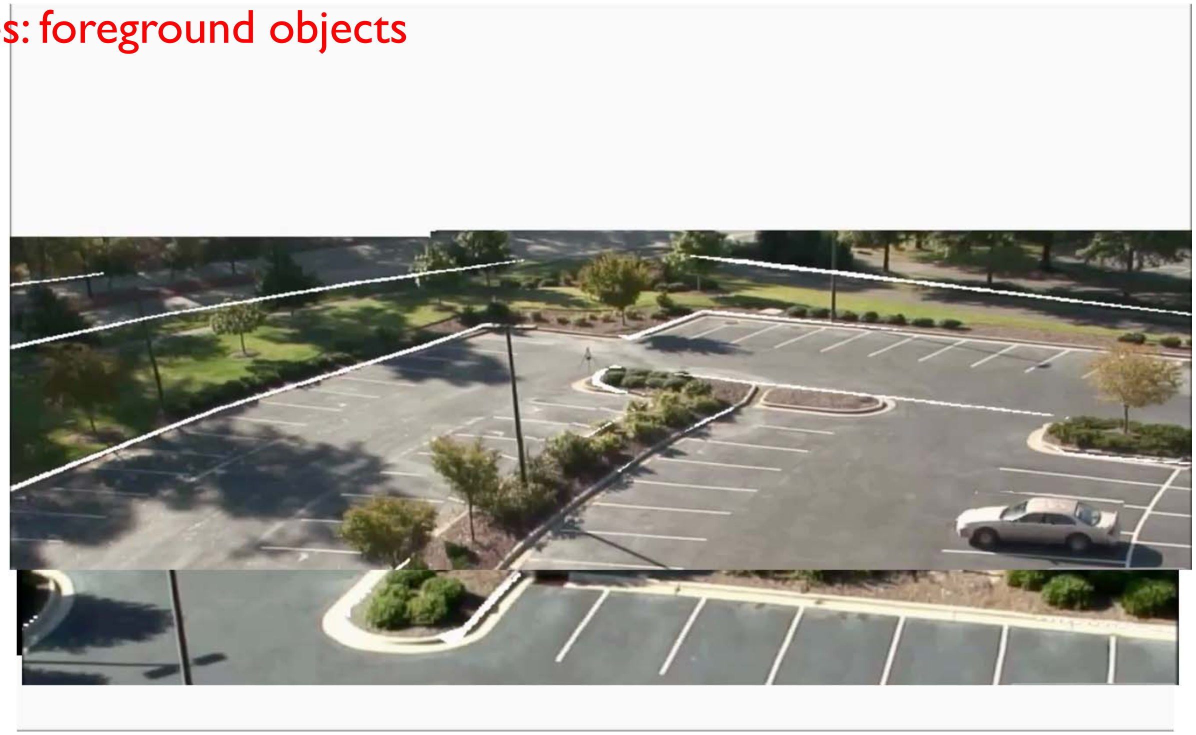


Demo 1: 3D Scene Reconstruction from a single image





Failure Cases: foreground objects



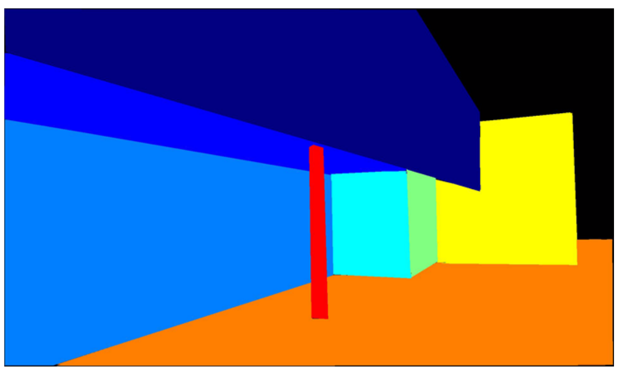
Synthesized Views

Demo 2: Scene Construction from Monocular Video

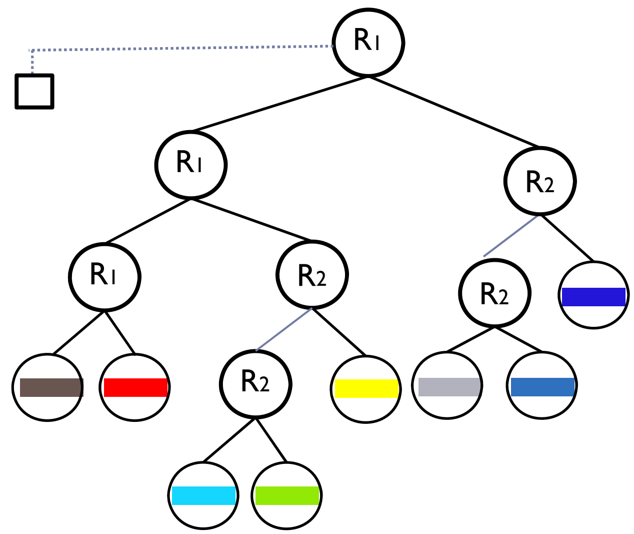
(captured by a mobile phone camera)

Input video sequence

Families of Parallel lines

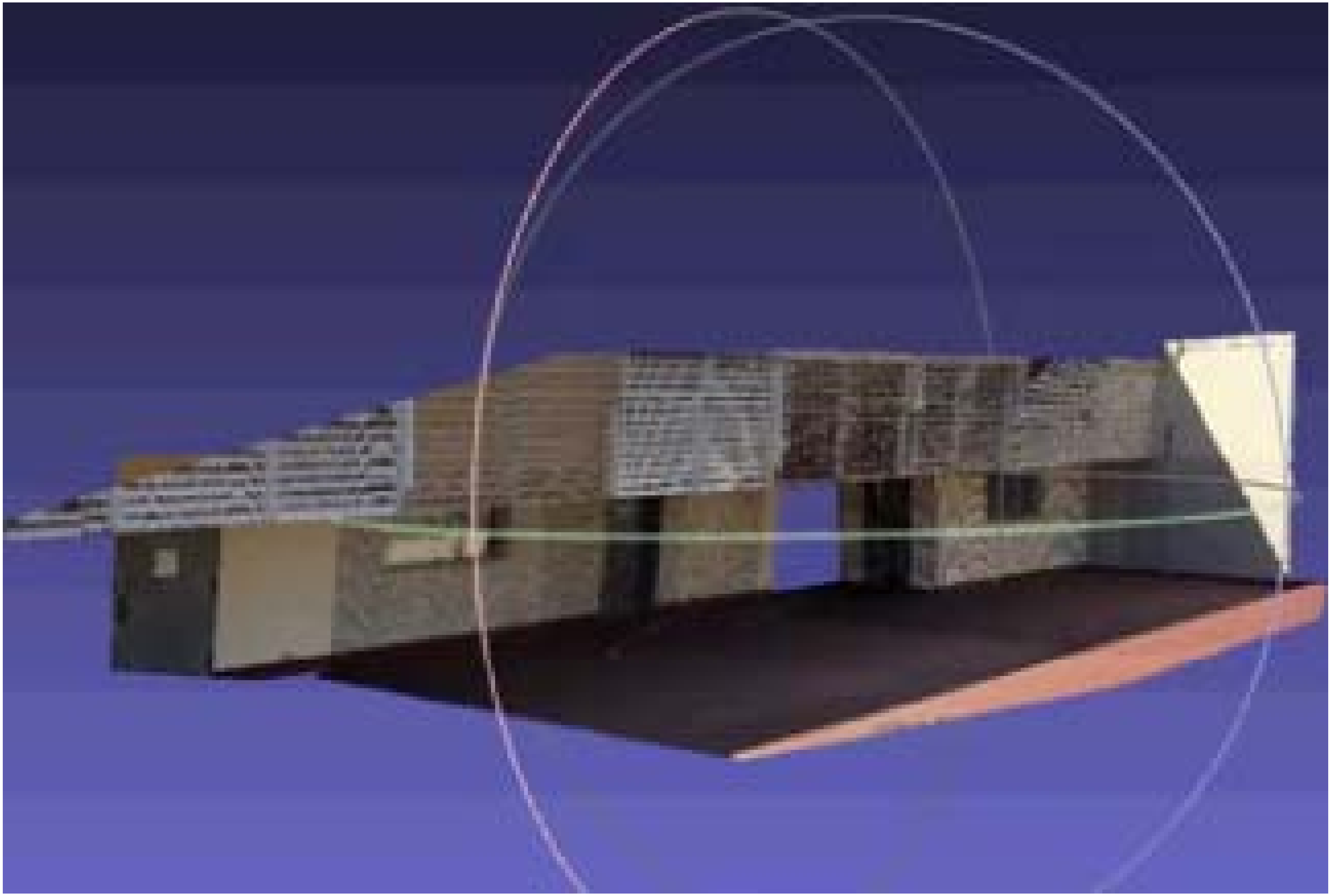


Layout Recovered

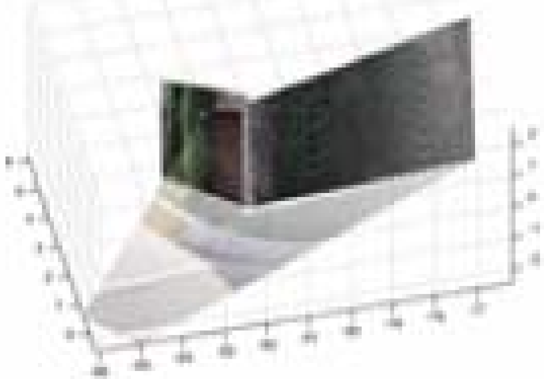


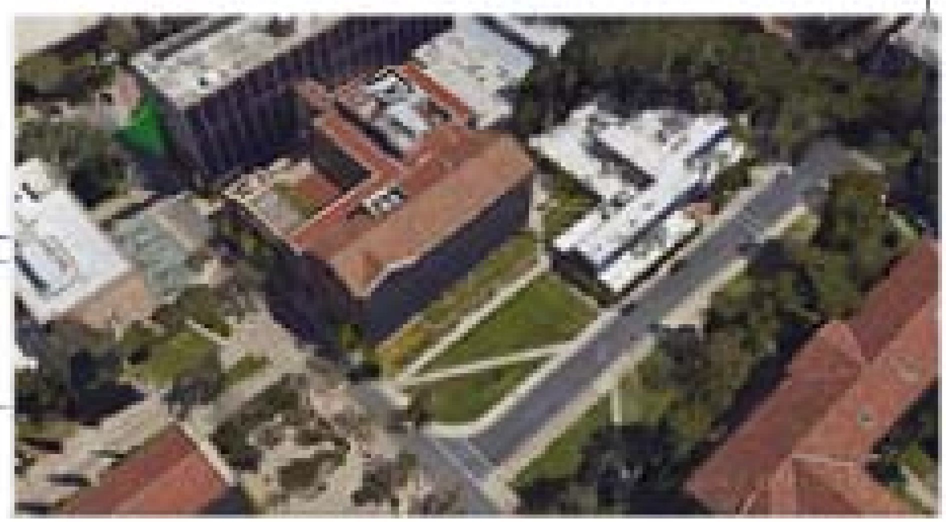
Notations	R_1: layout	R_3: affinity
R_2: siding	R_4: mesh	R_5: terminal

Recovered 3D



Demo 3: Scene Construction from Monocular Video





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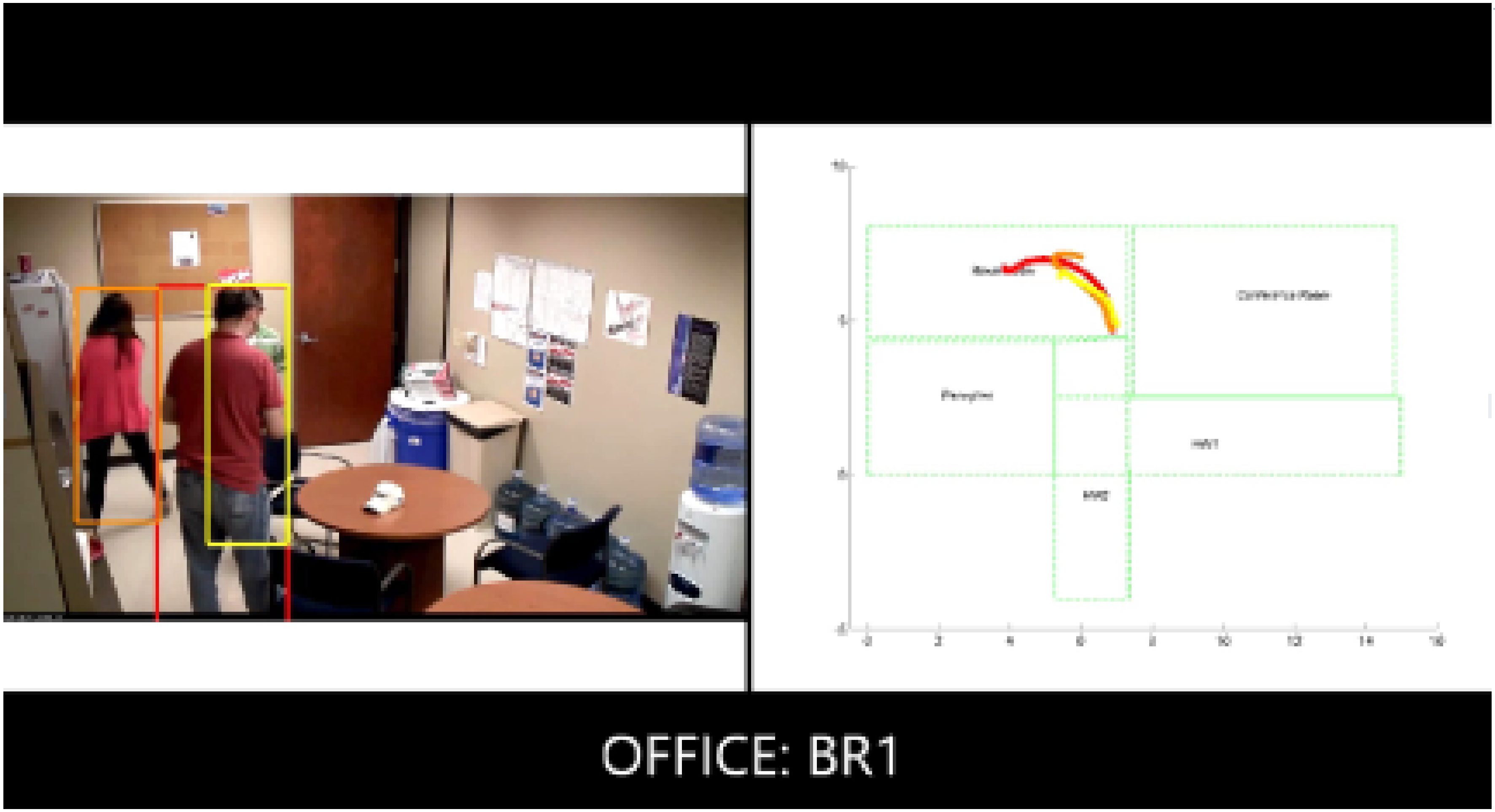
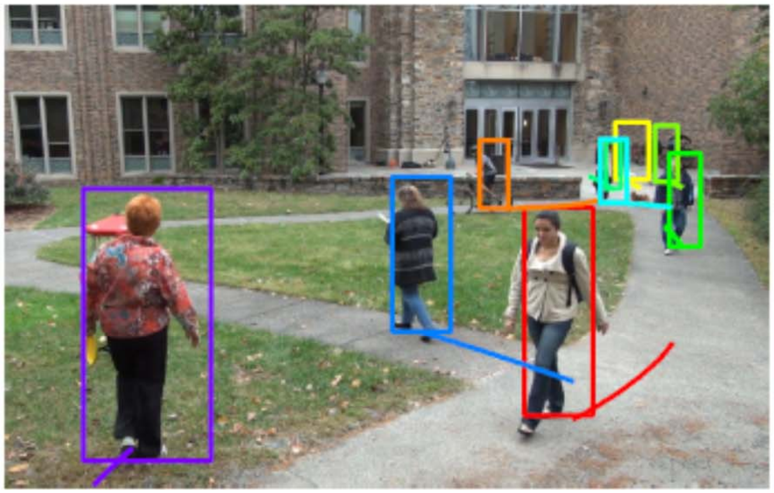
Demo 4: Geo-Localization of moving persons (Indoor)



Liu et al. AAAI'2016

Demo 5: Geo-Localization of moving persons (outdoor)

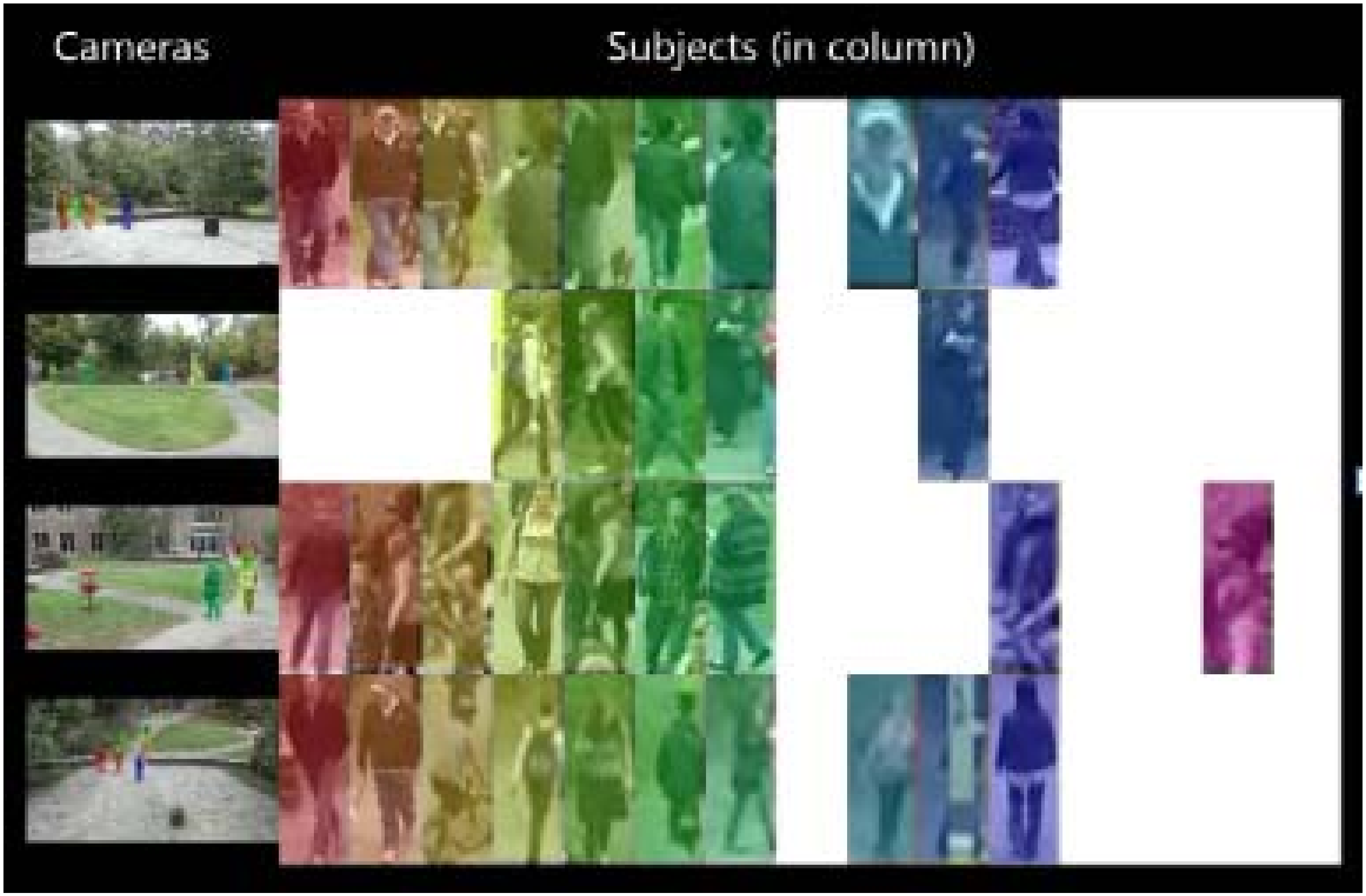


2D Trajectories

3D Trajectories

Liu et al. AAAI'2016

Demo 6: Multiple-View Multiple Person Tracking



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Question & Answer