Symmetry Detection Competition

Evaluation Details

PART II: Translation Symmetries

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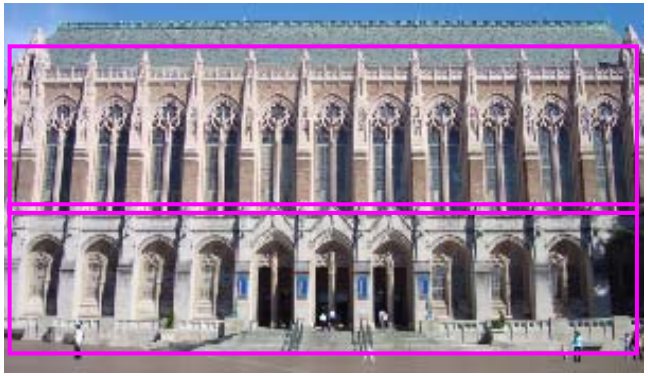
Translation Symmetry

Translation Symmetry

– Translation symmetries considered
  - 1D: Frieze Pattern
  - 2D: Wallpaper pattern

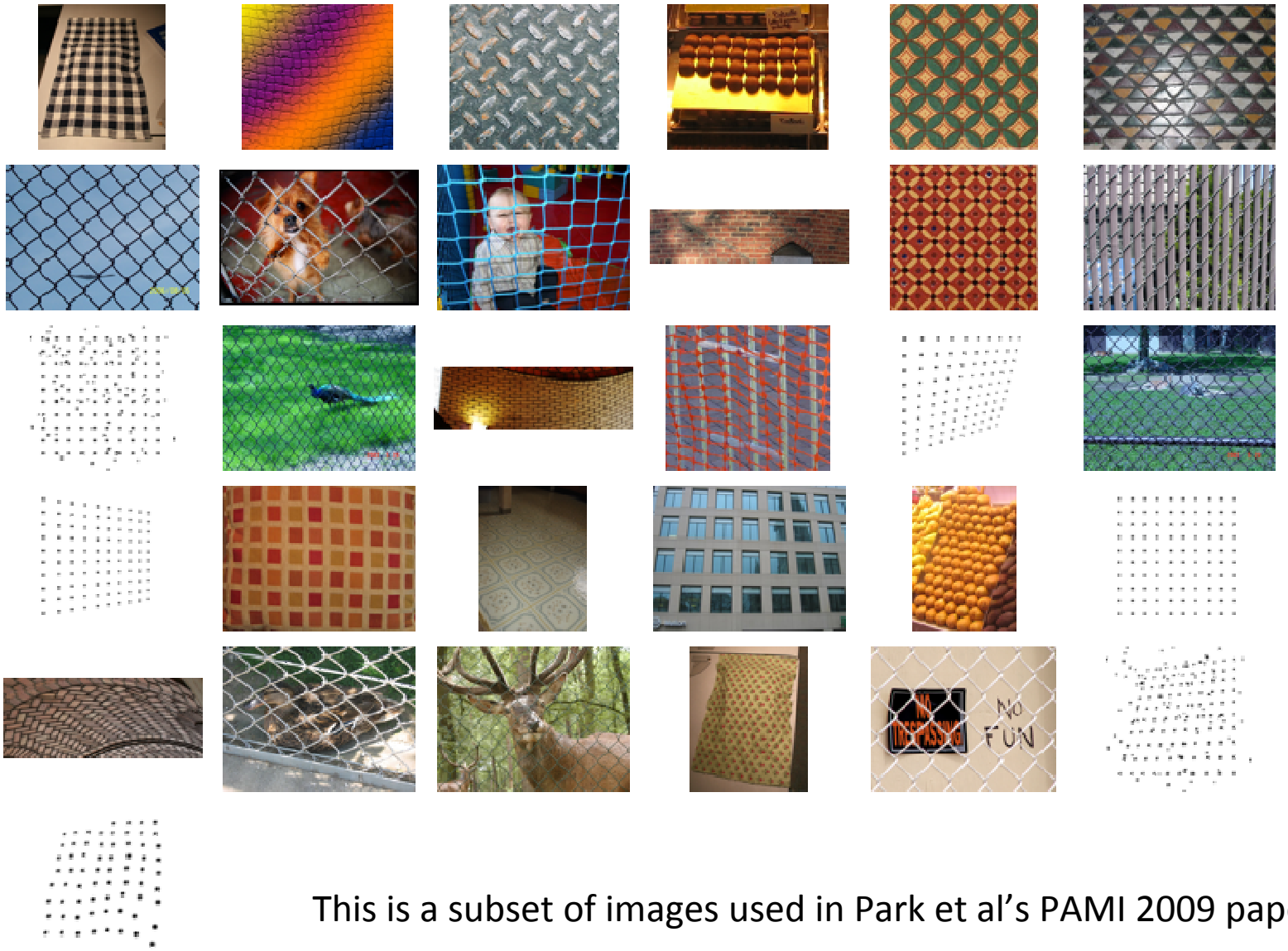
– Examples

Frieze



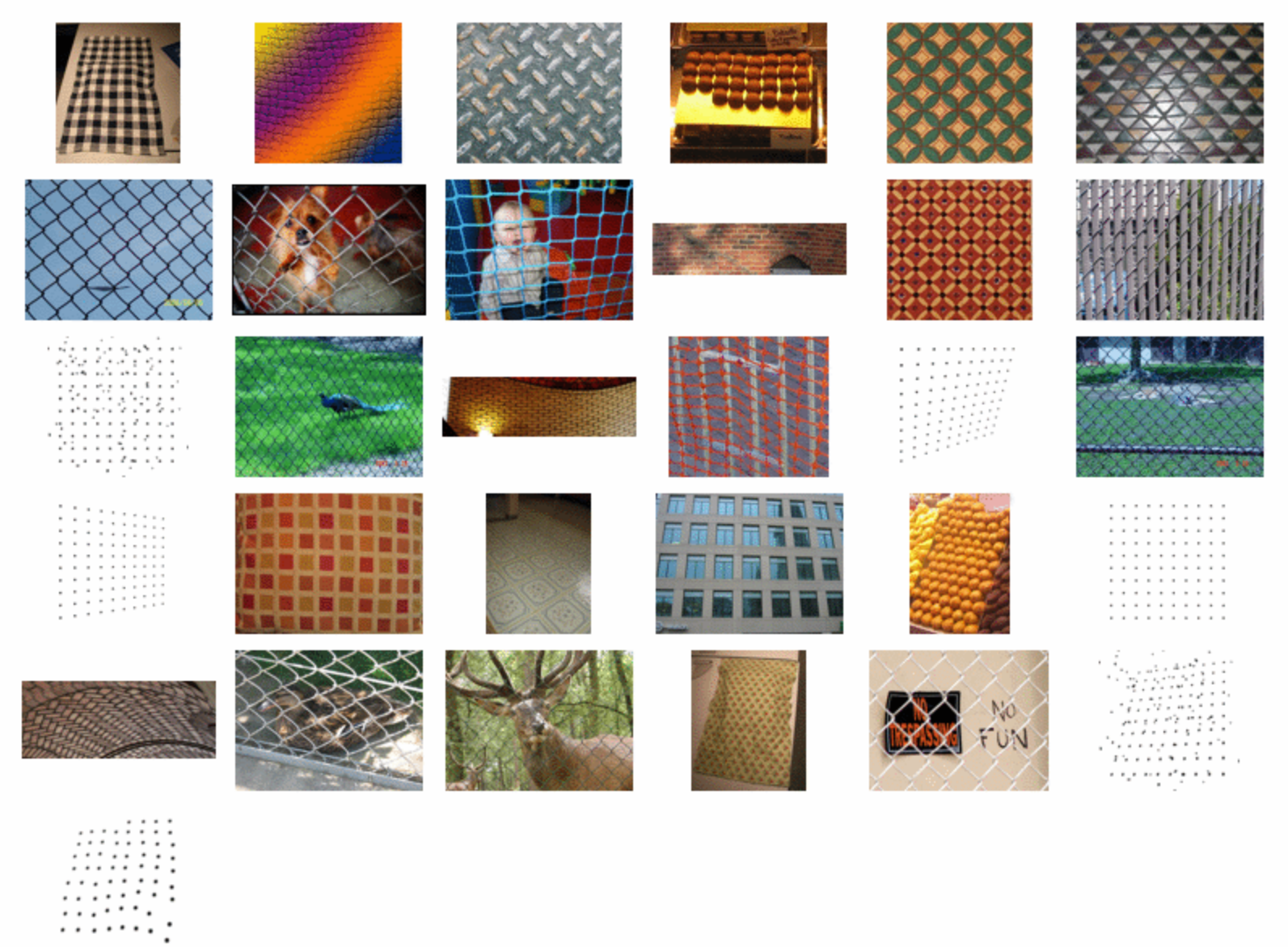
Wallpaper

Lattice – Test Set

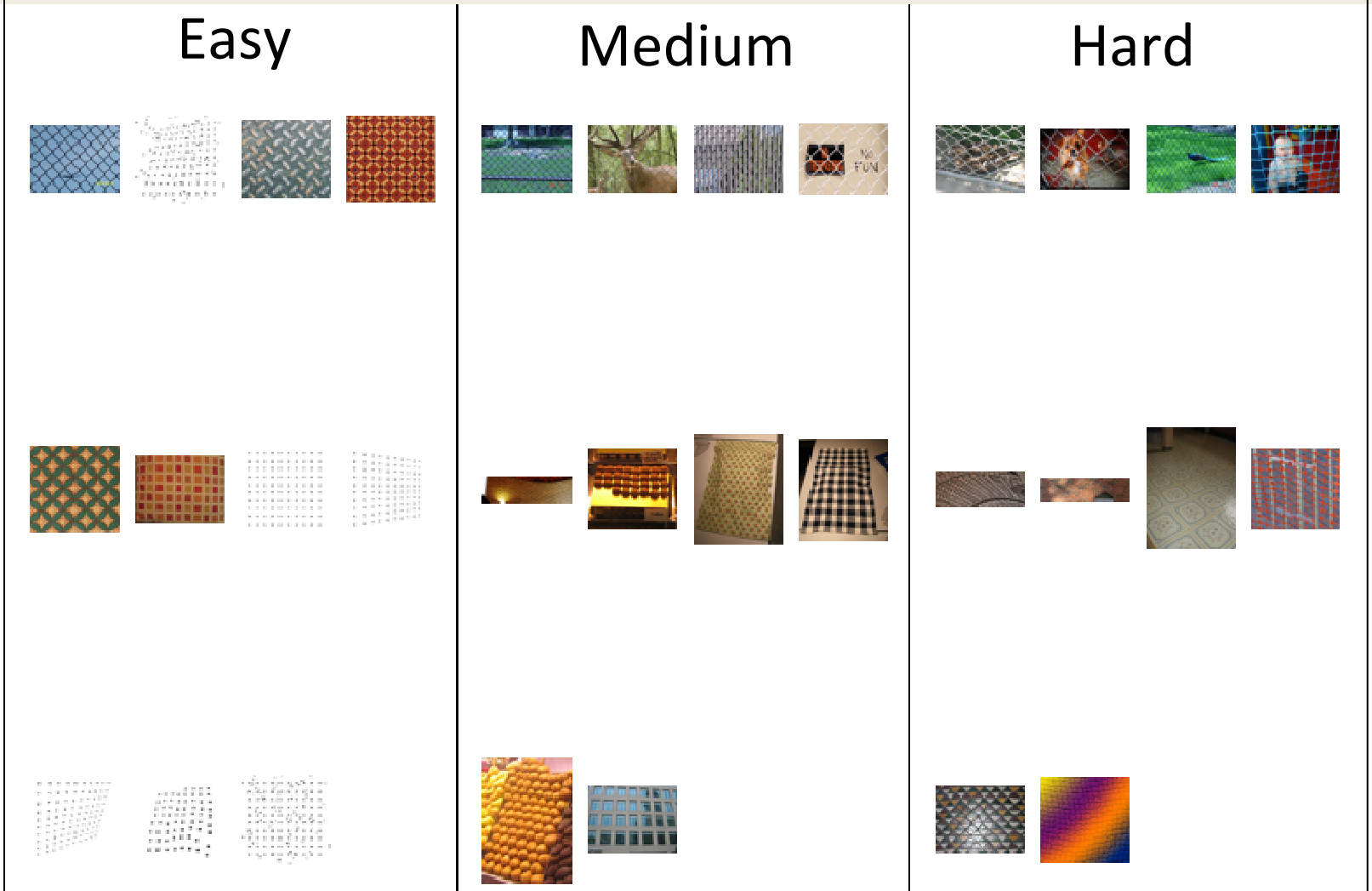


This is a subset of images used in Park et al's PAMI 2009 paper

Lattice - Dataset



Lattice - Dataset

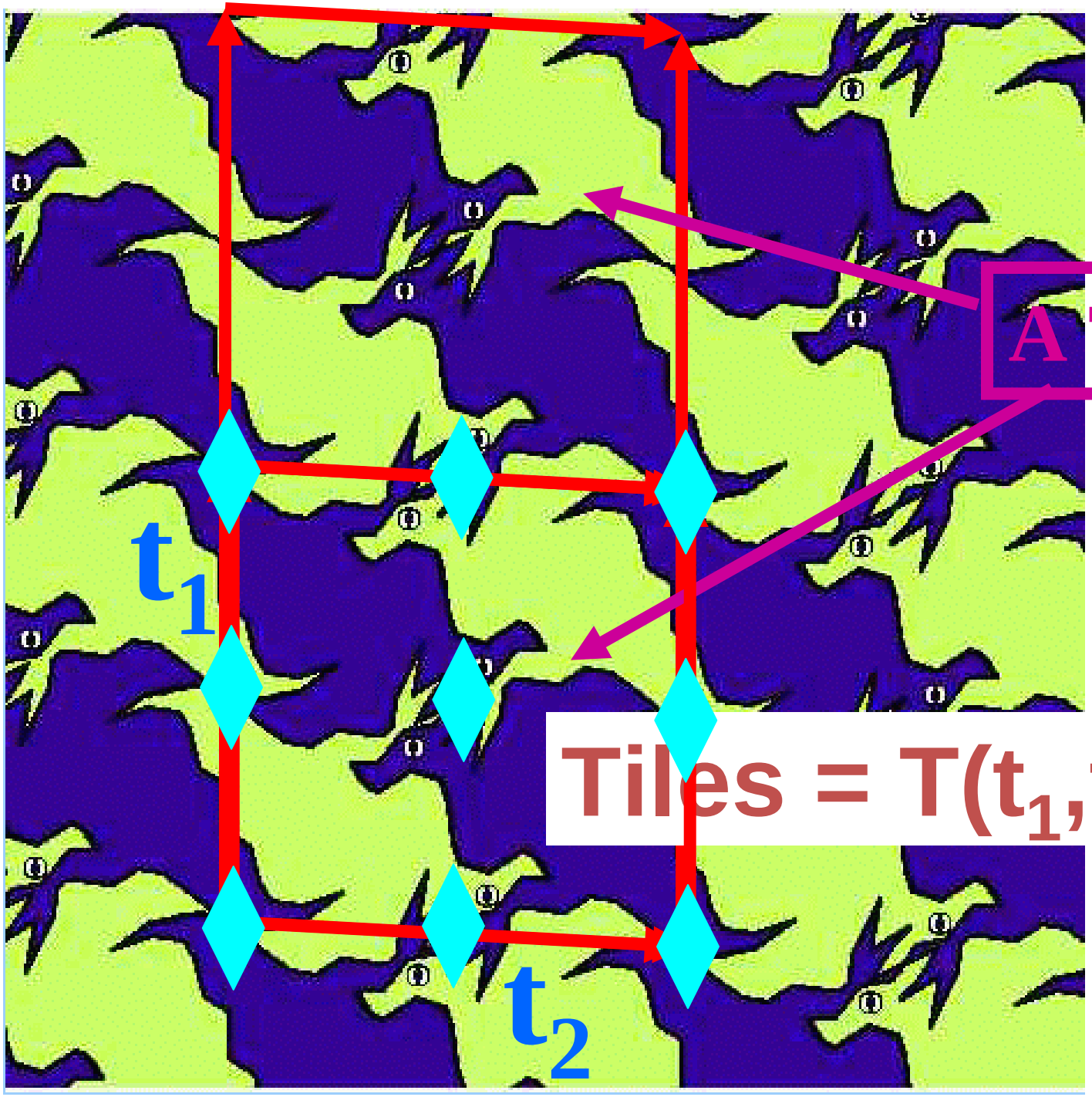


Lattice Detection: Dataset - Groundtruth

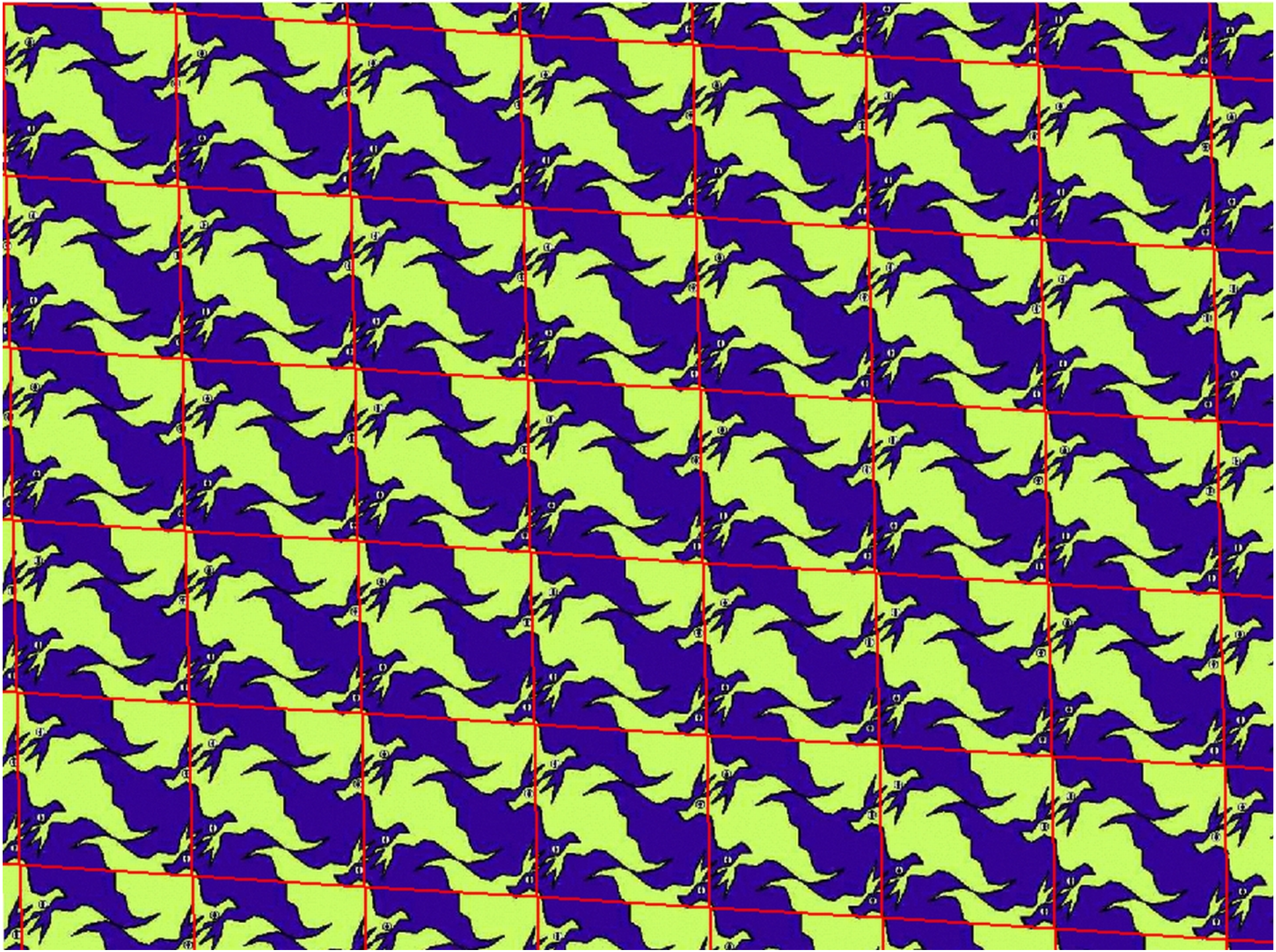
Images: 31

Easy		Medium		Hard	
#Images	**#Texels**	**#Images**	**# Texels**	**#Images**	**# Texels**
11	**536**	**10**	**1330**	**10**	**702**
					

Wallpaper Pattern



p2



Lattice Detection: Dataset - Groundtruth

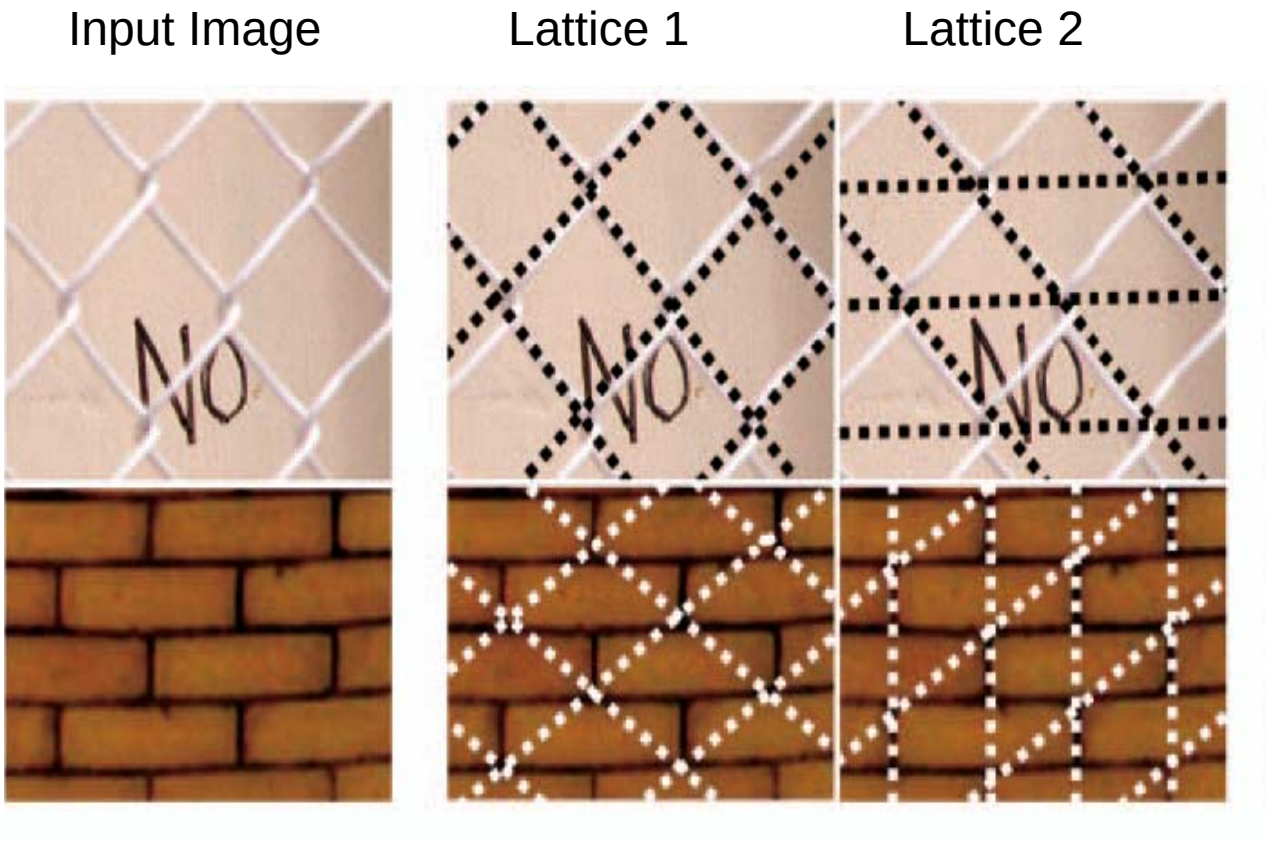
A lattice is defined

- as a regular grid
- with vertices defined at the corners of each texel

A texel is defined

- as a quadrilateral ,
- that when repeated along two vectors (T1 and T2), reproduces the pattern seamlessly

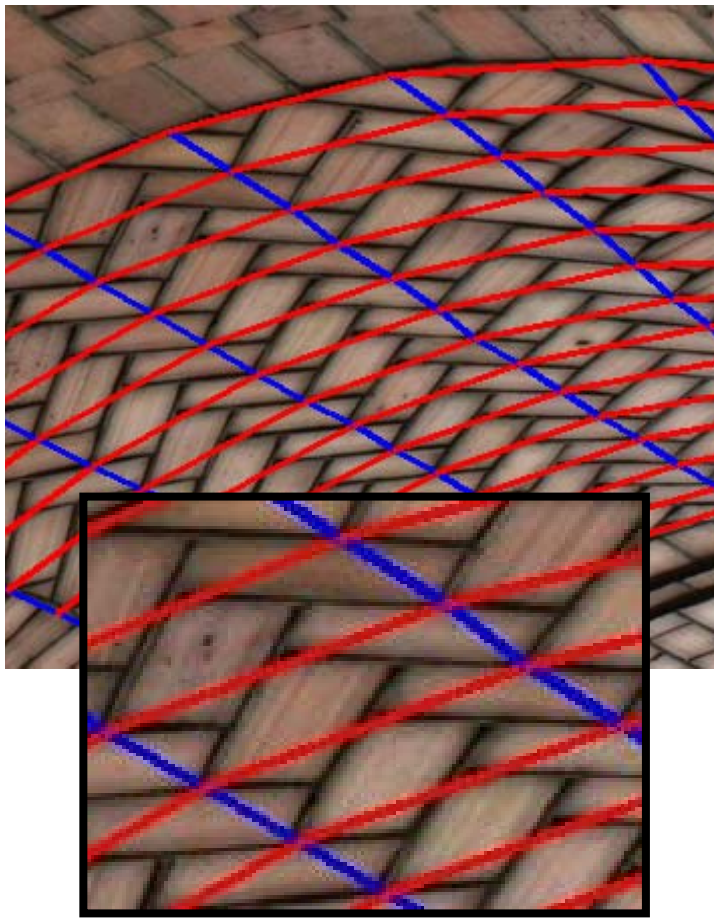
Lattice Detection: Dataset - Groundtruth



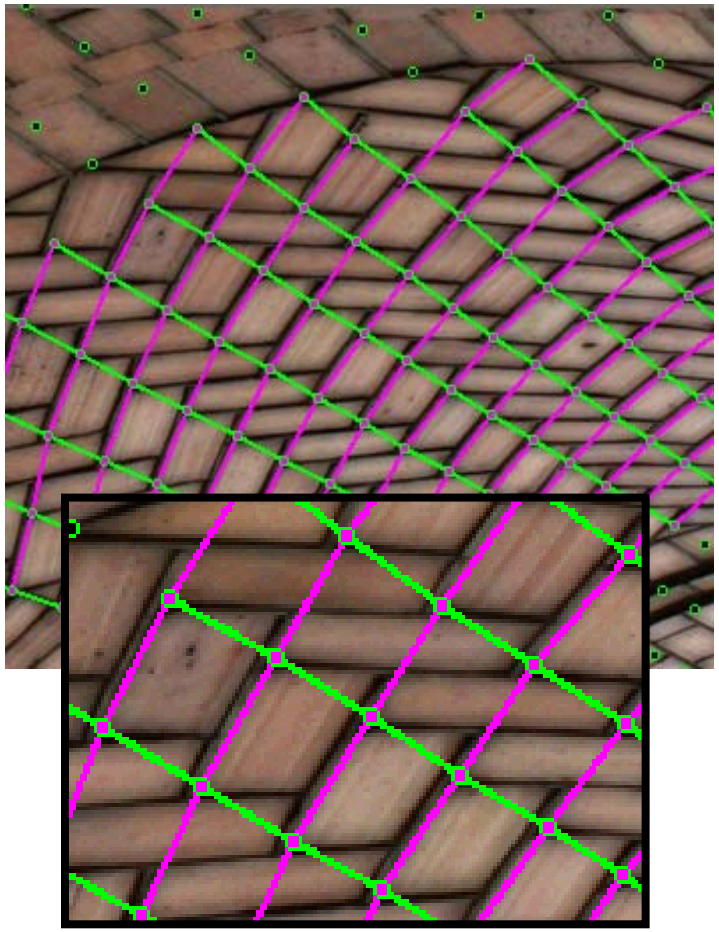
- Different valid quadrilateral lattices (varying texel shapes)

Lattice Detection: Groundtruth Labeling

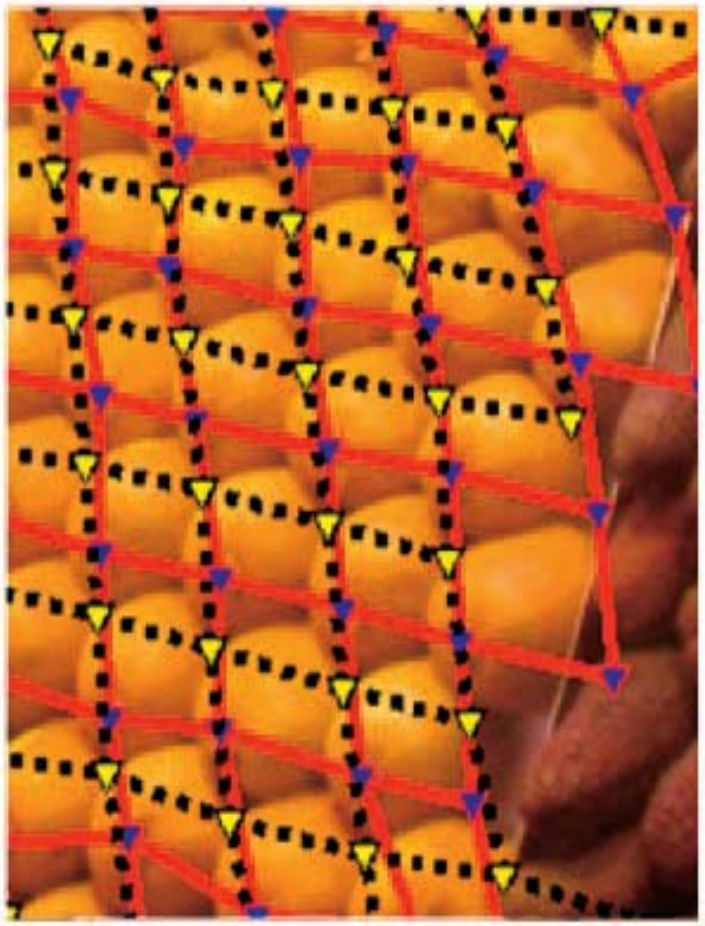
Correct



Incorrect



Lattice Detection: Evaluation Metric



A global offset between ground truth (red) and detected lattice (dotted black)

- Count number of correct texels (True Positives, TP)
- A quadrilateral lattice is “correct” if all its four corners match up to corners in the ground truth
- Align lattices by minimizing a distance cost-function between paired lattice points that applies a globally linear transformation to all detected lattice points

Translation Symmetry: Evaluation Score

- We use ***precision*** and ***recall*** to judge algorithm performance
- In terms of Type I and Type II errors

Precision = TP / (TP + FP) Recall = TP / (TP + FN)	TP = True Positives, FN = False Negatives FP = False Positives

- Precision and recall scores are computed and then averaged over all test images
  - Avoids bias towards images with large number of texels

Results and Comparison

Lattice Detection: Contestants

- Yunliang Cai
  - Hong Kong Polytechnic
- Changchang Wu, Jan-Michael Frahm and Marc Pollefeys
  - University North Carolina, USA

Lattice Detection: Baseline

– Minwoo Park et al.
  - Pennsylvania State University, USA
  - M. Park, K. Brocklehurst, R. T. Collins, and Yanxi Liu (2009), Deformed Lattice Detection in Real-World Images using Mean-Shift Belief Propagation, IEEE Transaction on Pattern Analysis and Machine Intelligence (TPAMI). Vol. 31, No. 10.

Translation Symmetry: Considerations for Evaluation

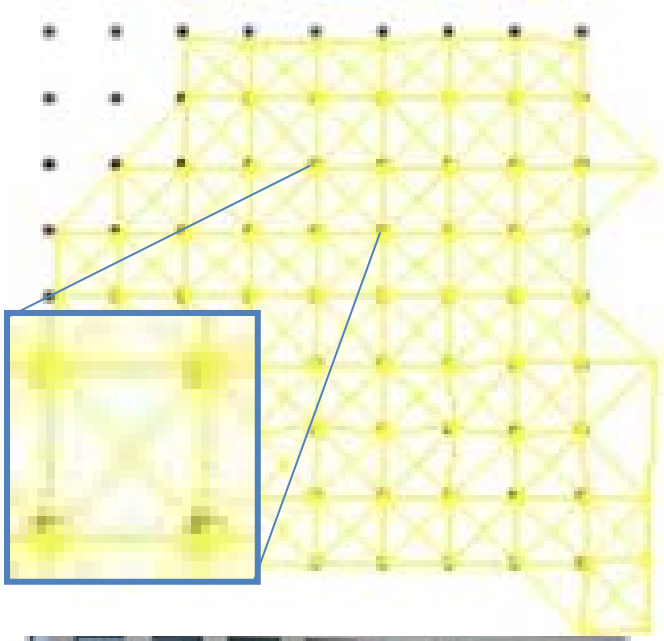
- Yunliang Cai's method
  - Requires user input (a box specifying initial texel estimate)
  - Result output is point cloud with unspecified degree of neighborhood connectivity
  - Not clear how to convert into lattice structure for comparison

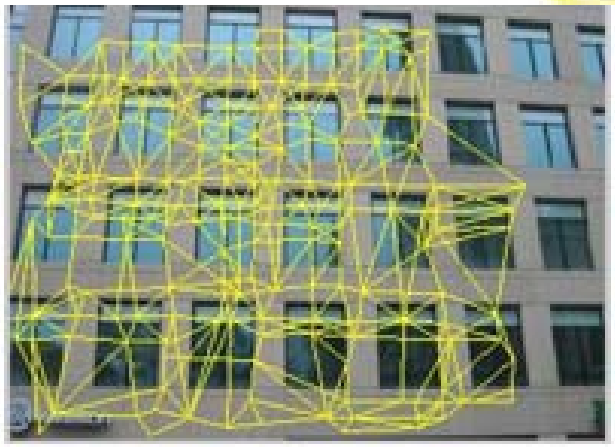
- Changchang Wu's method
  - Designed for frieze pattern detection
  - Requires strong horizontal features for vanishing point detection
  - Does work on some lattice images as well

- Minwoo Park's method
  - Fully automatic
  - Result output is a valid lattice grid, with individual texels

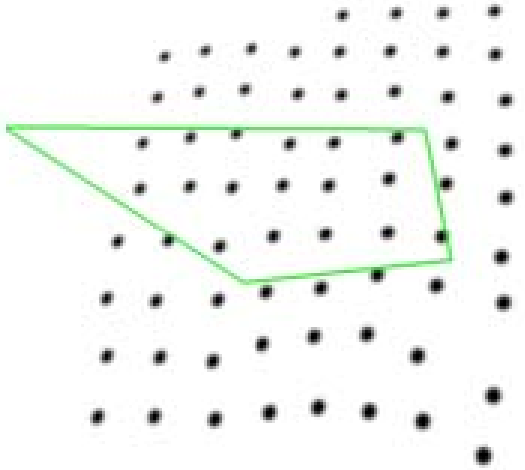
Translation Symmetry: Considerations for Evaluation

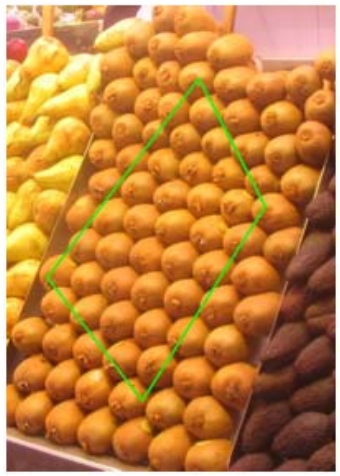
Cai's output not a valid lattice structure





Wu's output often only shows vanishing lines





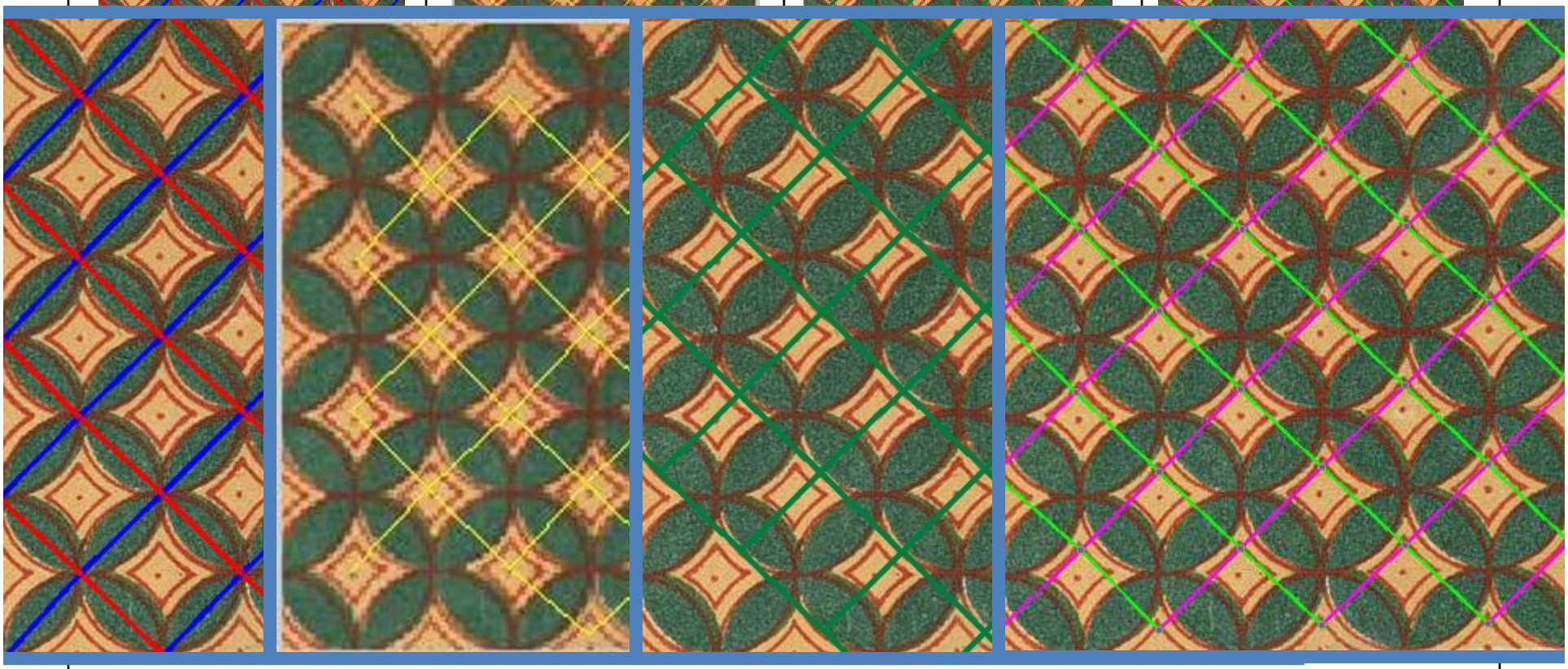
Lattice Detection: Results

- We attempt quantitative evaluation by
  - Transforming output into lattice form when possible
  - Discounting images for which output cannot be transformed into a lattice

- Number of valid images: 4

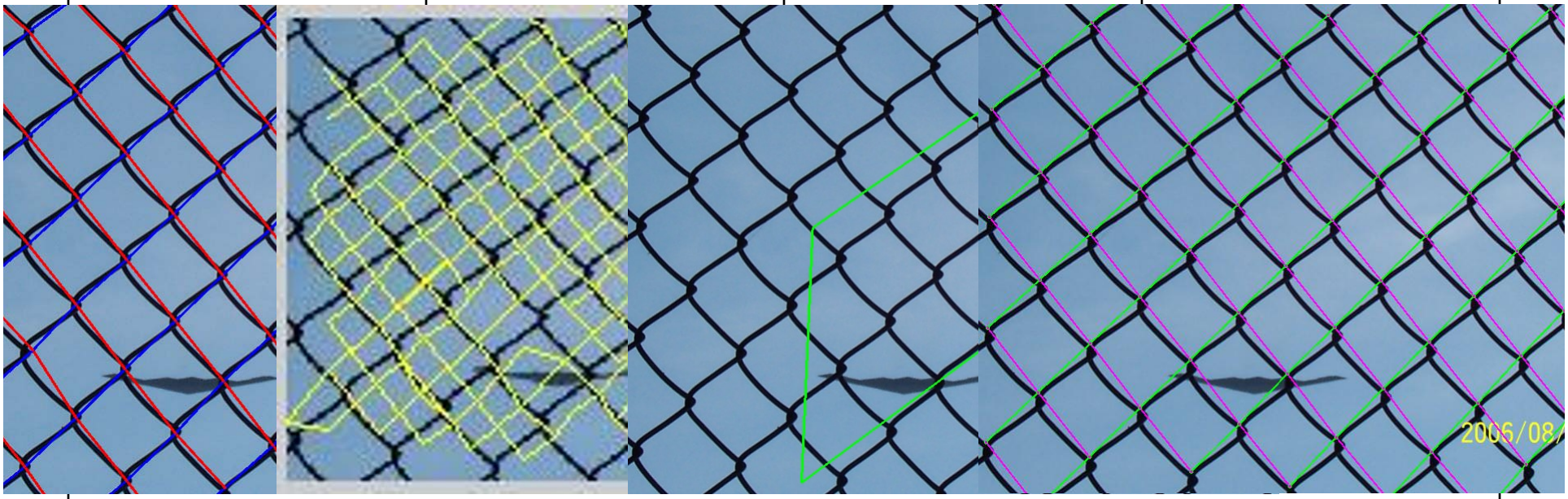
Lattice Detection: Results - Easy

Groundtruth	Y. Cai	C. Wu	M. Park
GT: 30	TP: 14, FP: 0	TP: 20, FP: 0	TP: 21, FP: 0

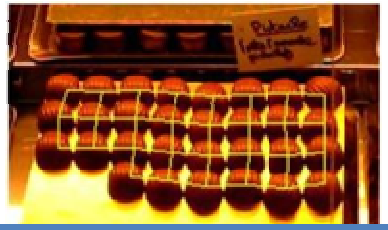
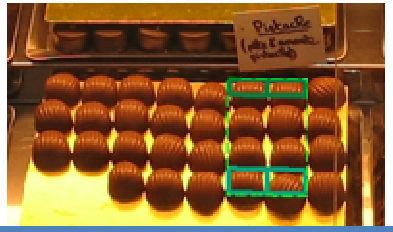


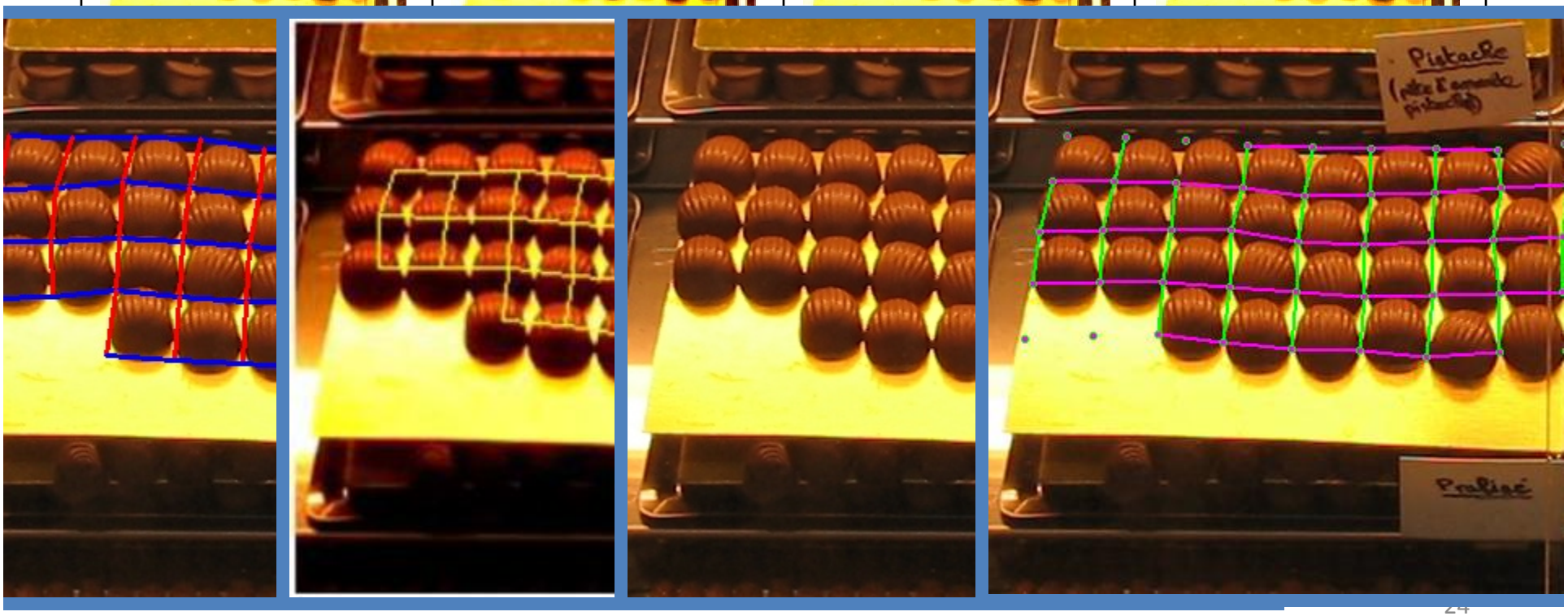
Lattice Detection: Results - Easy

Groundtruth	Y. Cai	C. Wu	M. Park
GT: 64	TP: 0, FP: 193	TP: 0, FP: 1	TP: 52, FP: 0

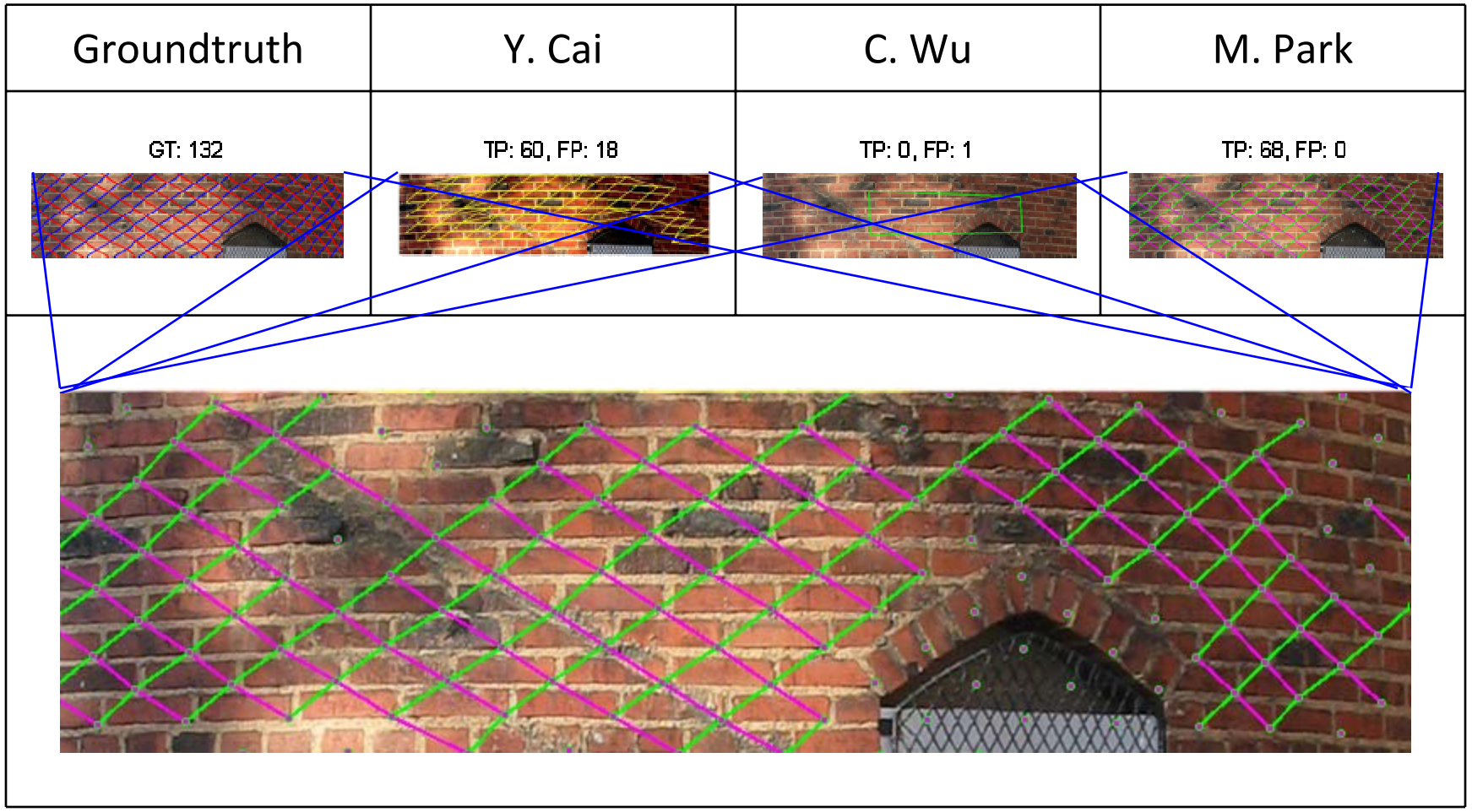


Lattice Detection: Results - Medium

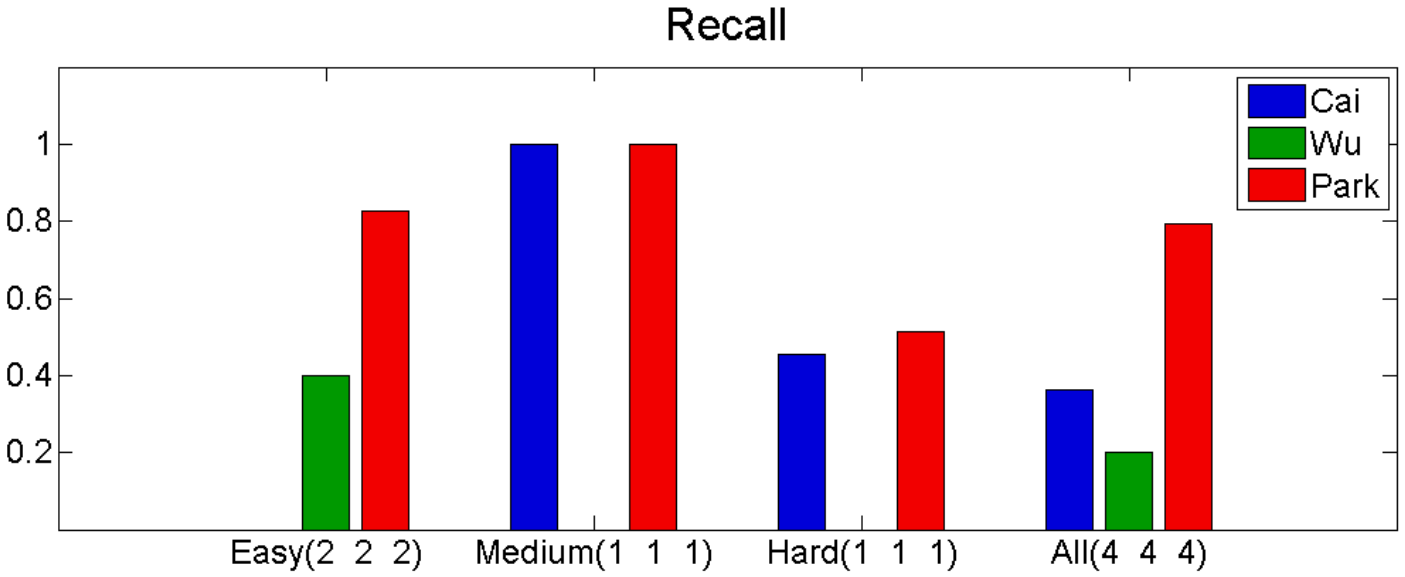
Groundtruth	Y. Cai	C. Wu	M. Park
GT: 19	TP: 19, FP: 0	TP: 0, FP: 4	TP: 19, FP: 0
			

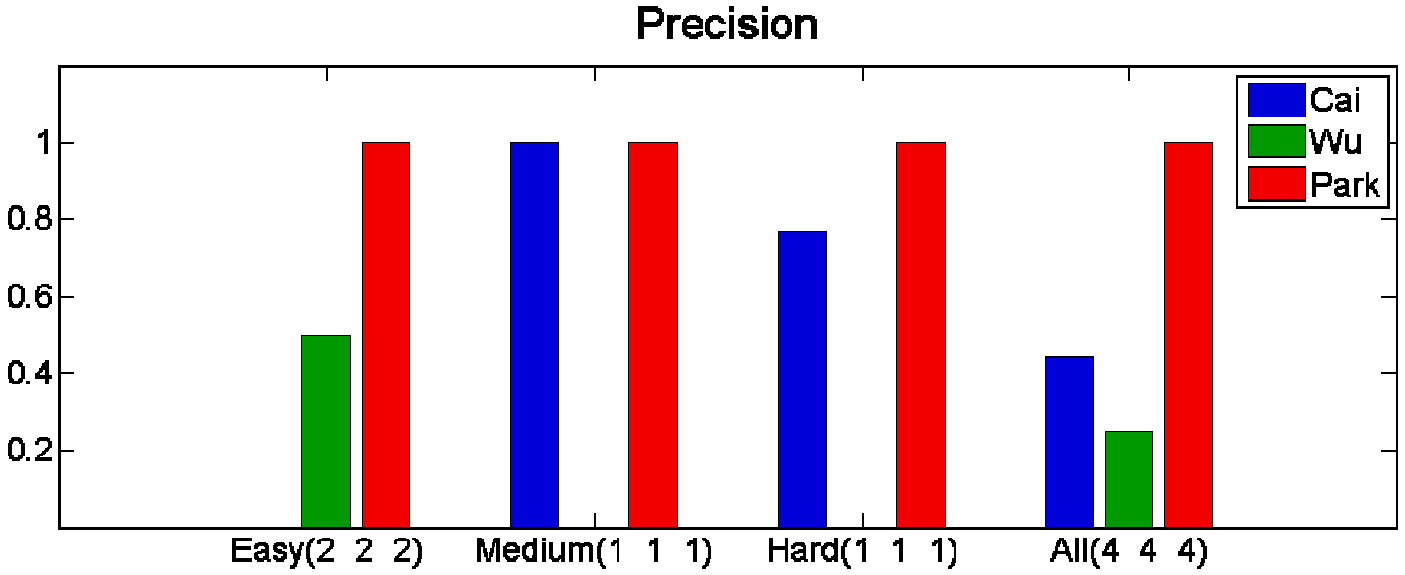


Lattice Detection: Results - Hard



Lattice Detection: Quantitative Results 1





Number triplet (a,b,c) means number of images used for each contestant. Here we used the only four images for which all contestants got valid results.

Lattice Detection: Quantitative Results 2

- Evaluate each algorithm separately
  - only valid outputs counted
- Algorithm Performances cannot be directly compared
  - Each algorithm has valid output on a different set of images

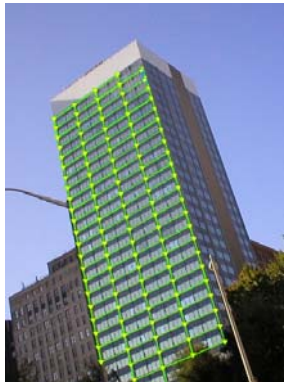
Additional Tests: Building Facades

Additional Tests

Building Facades

Additional Tests: Building Facades

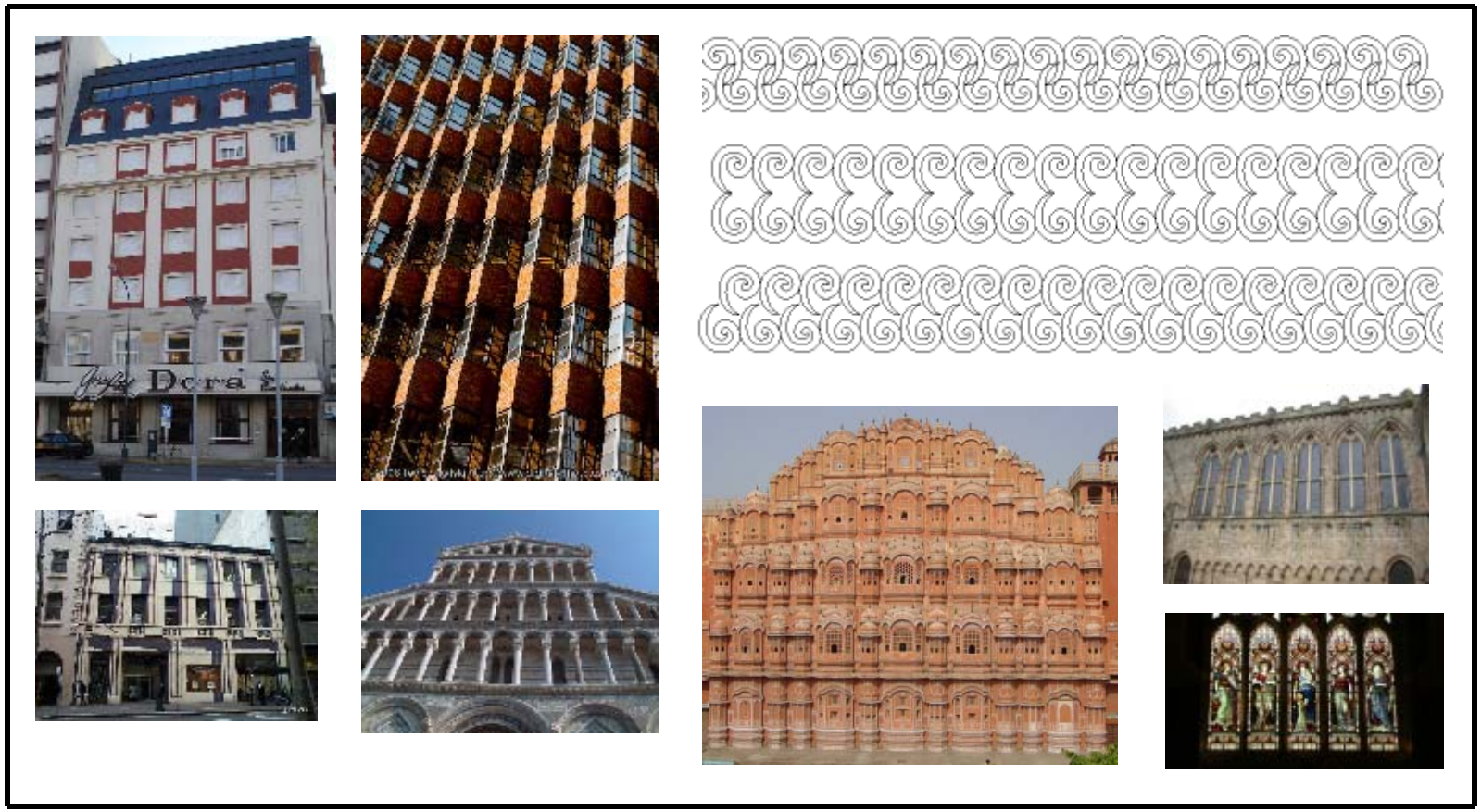
- Additional Testing on Wu's method
  - 1D Lattice from Frieze Pattern Detection
  - Emphasize on buildings with strong horizontal frieze patterns



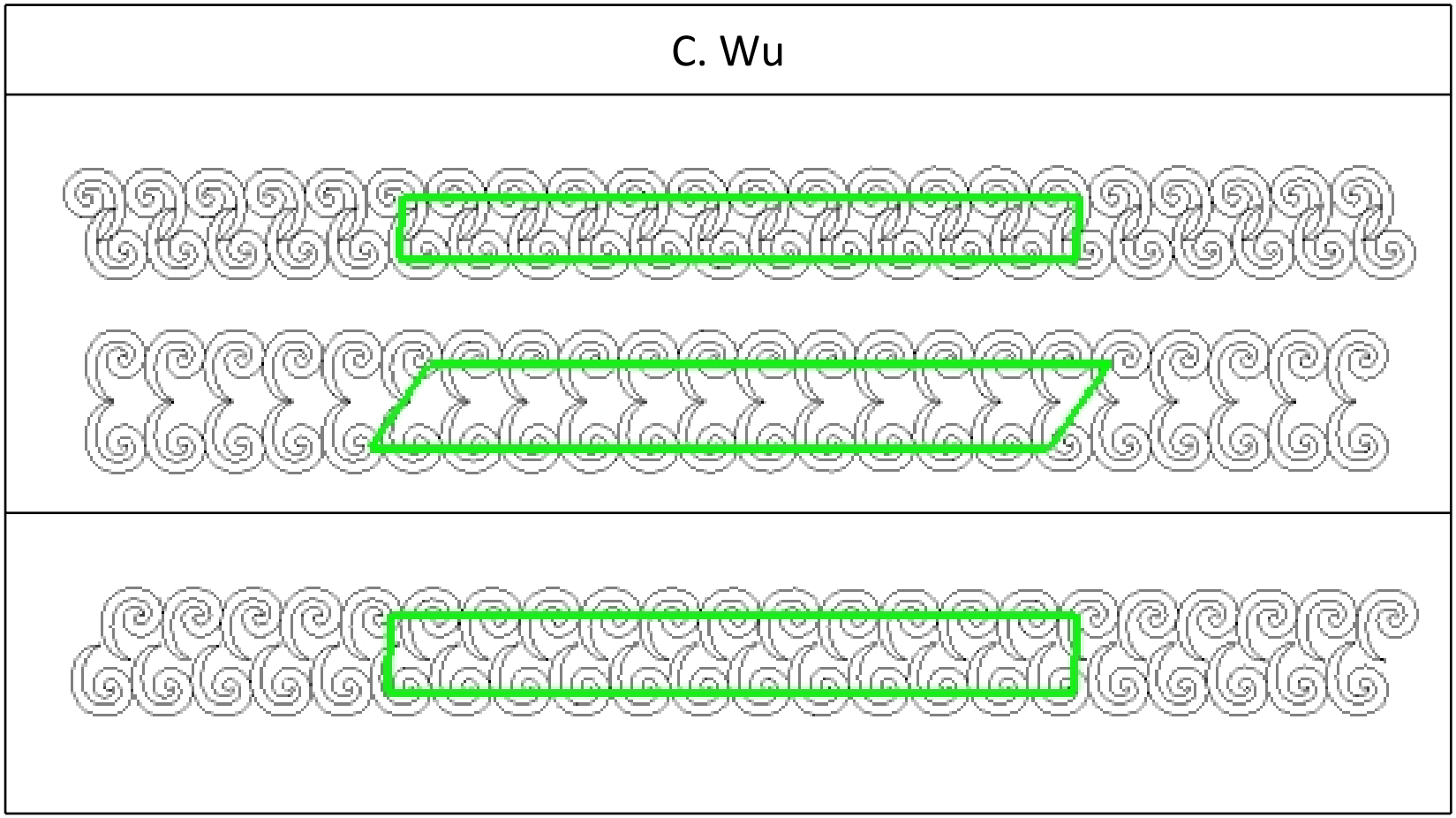
- Additional Testing on Cai's method
  - A comparison against Park's method published at ACCV, which was modified to use human input
  - Emphasize on sky scrapers with regular window patterns

Frieze Test Set

Total number of Images: 15

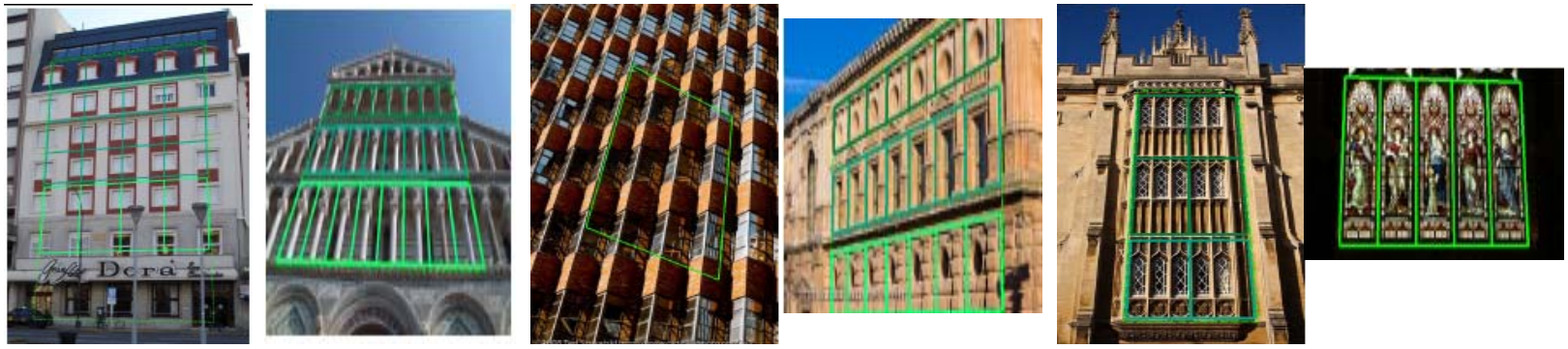


Frieze Detection Results



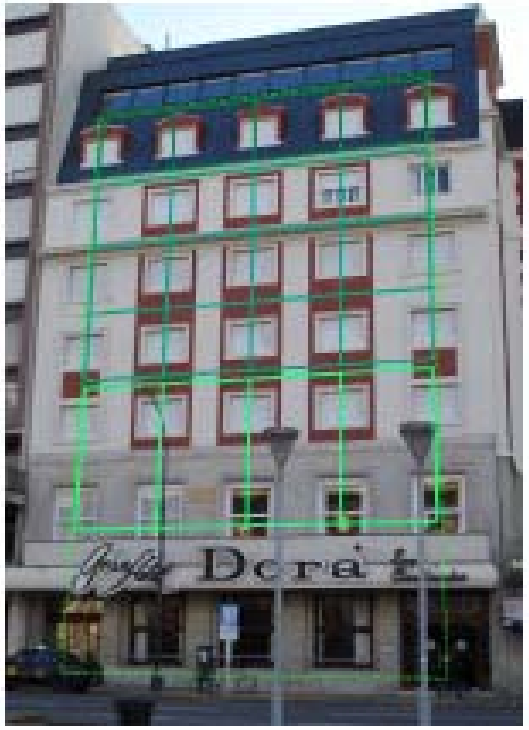
Frieze Detection Results

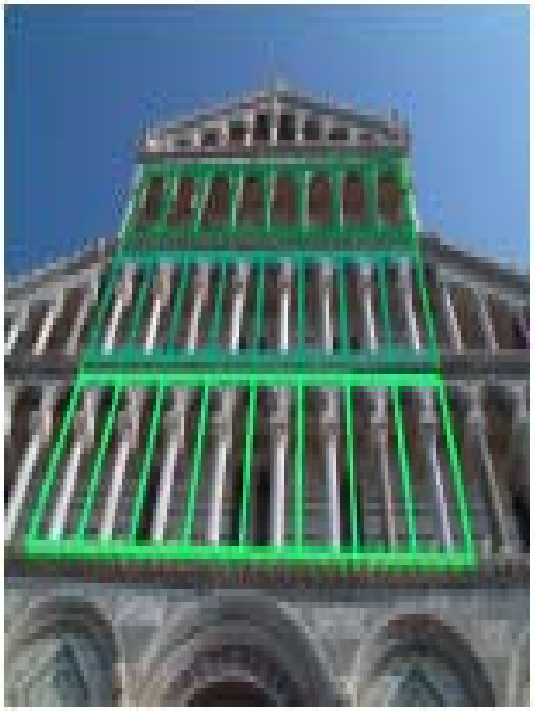
C. Wu

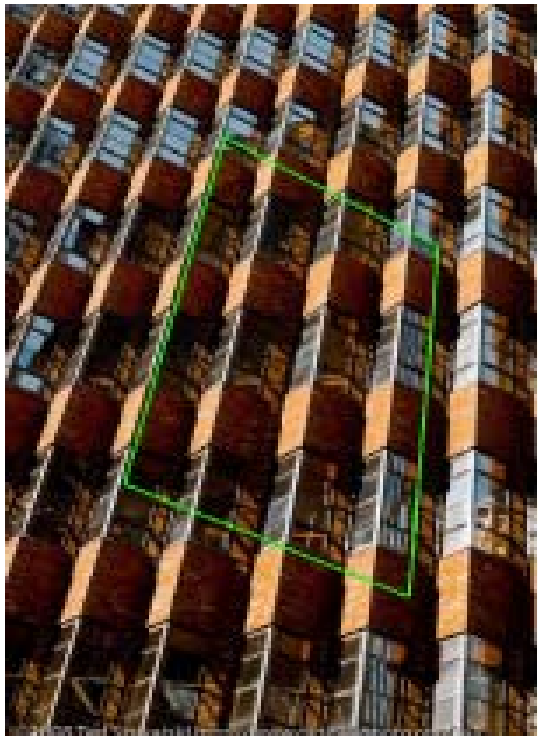


Frieze Detection Results

C. Wu

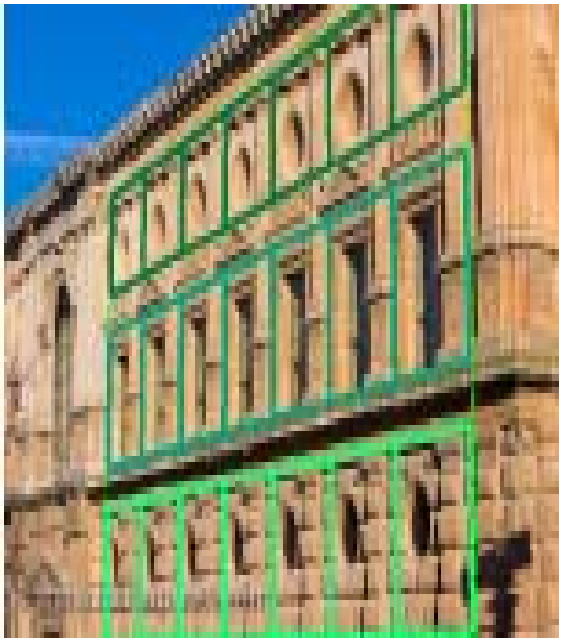


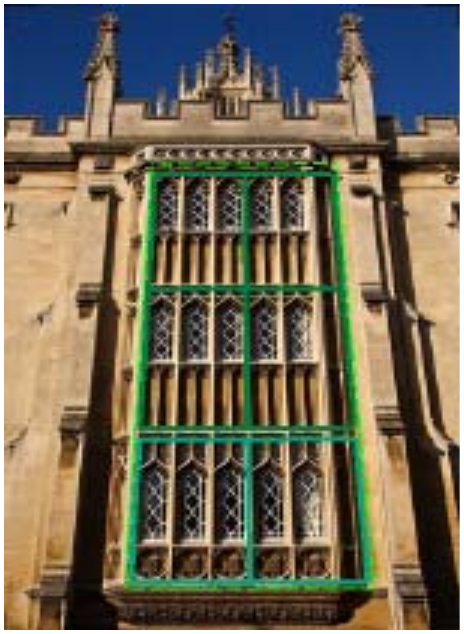




Frieze Detection Results

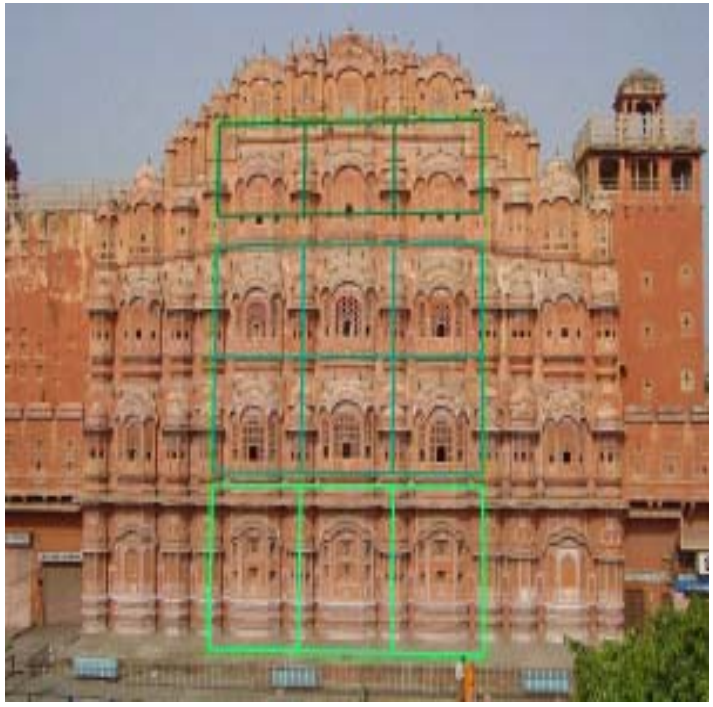
C. Wu

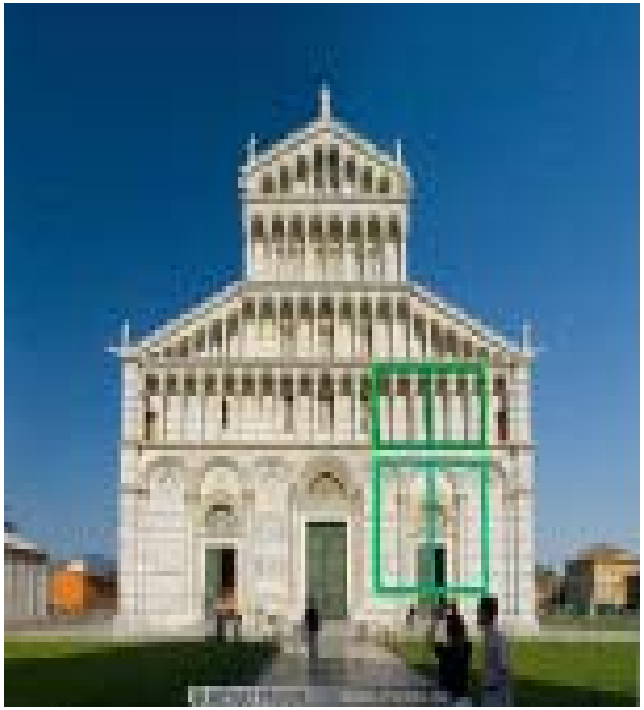




Frieze Detection Results

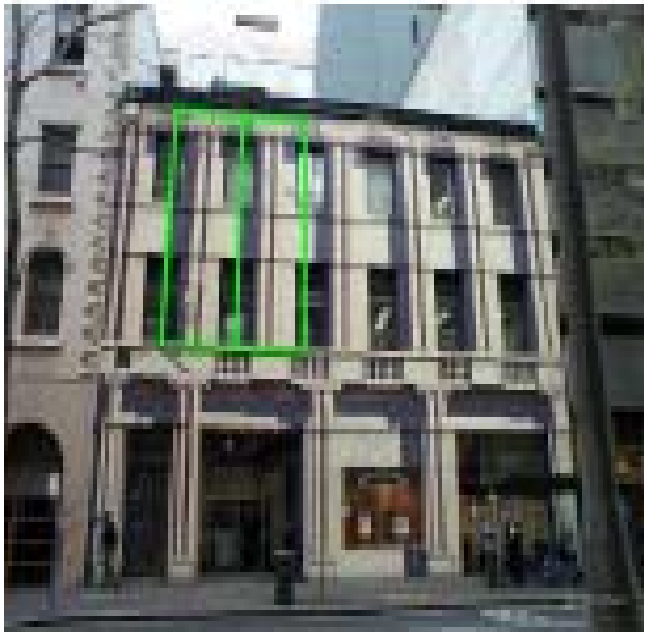
C. Wu





Frieze Detection Results

C. Wu



Facade Detection

– Image 1 / 4

Park et al (ACCV 2010)	Cai et al
	

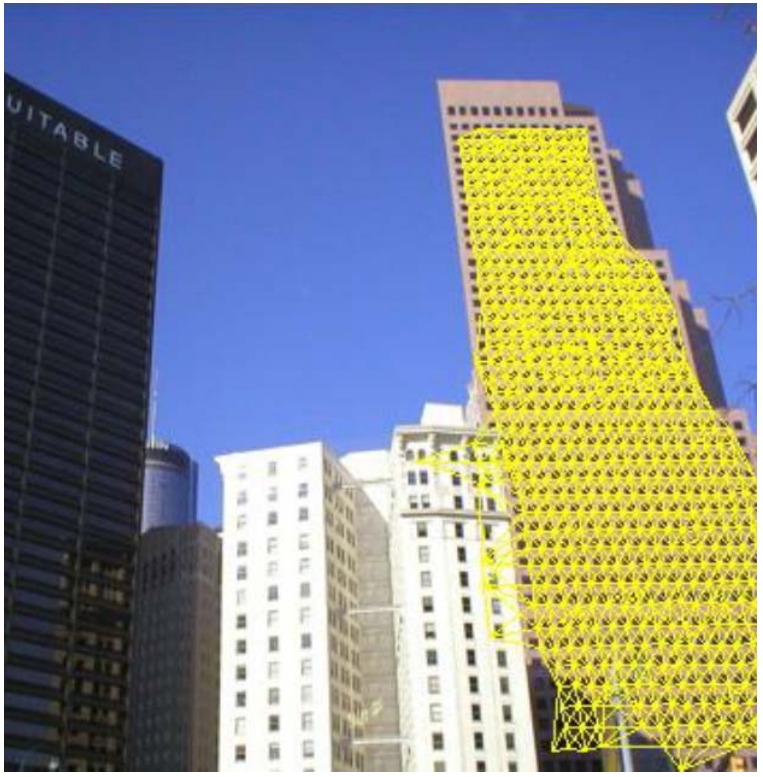
Facade Detection

– Image 2 / 4

Park et al (ACCV 2010)	C. Wu (requires input)
	

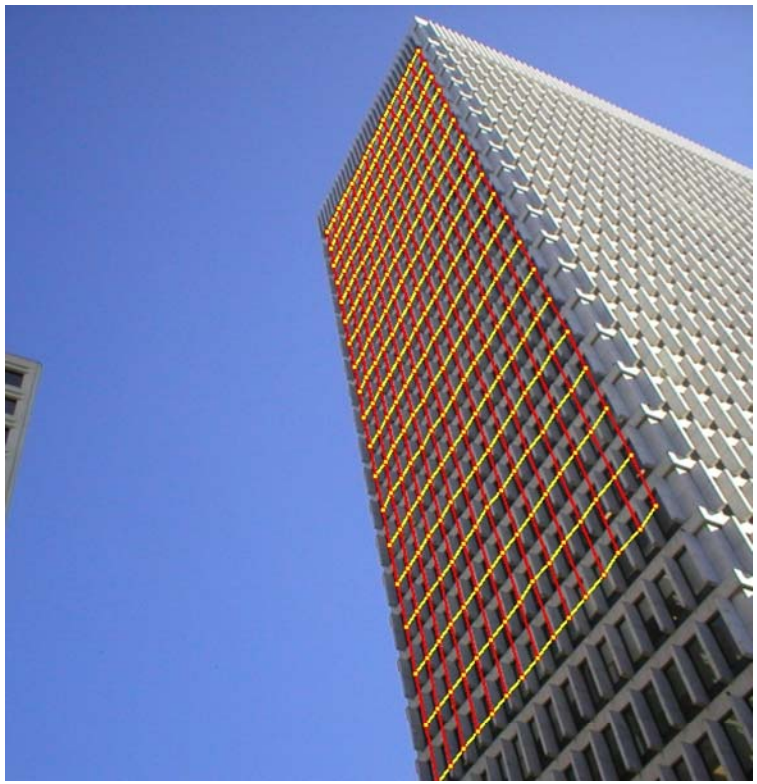
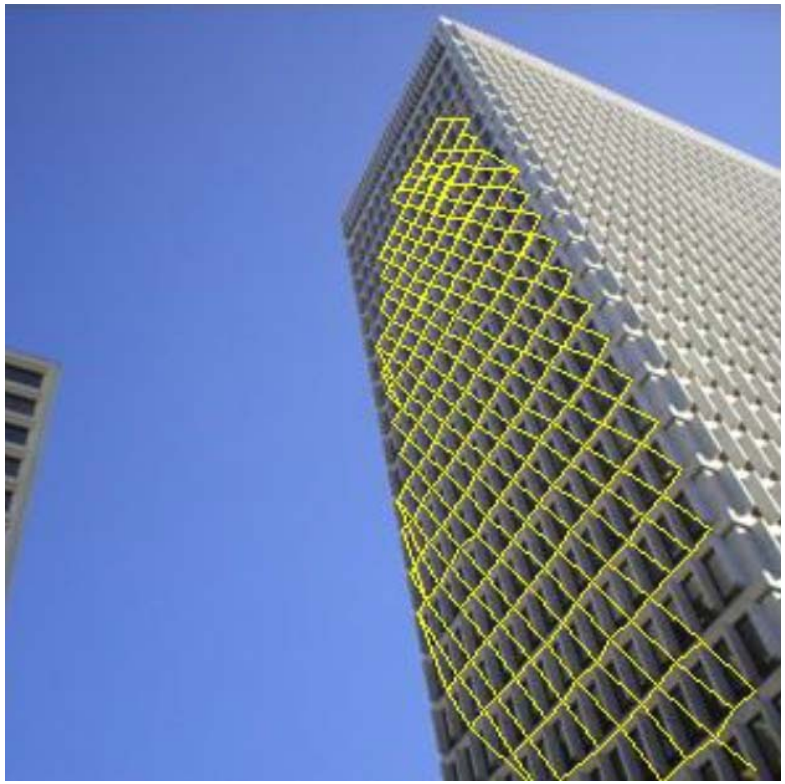
Facade Detection

– Image 3 / 4

Park et al (ACCV 2010)	Cai et al
	

Facade Detection

– Image 4 / 4

Park et al (ACCV 2010)	Cai et al
	

Facade Detection: Summary

- On valid output images

	Recall	Precision
Park et al.	0.95	1.0
Cai et al.	0.78	0.97

The End