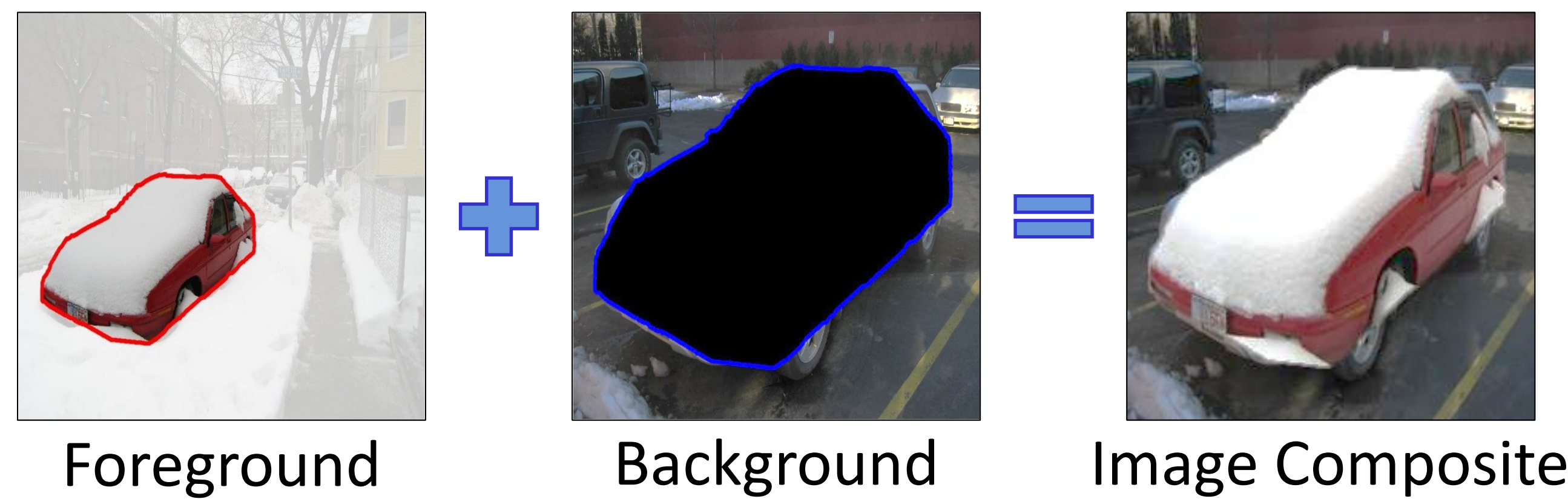# Learning a Discriminative Model for the Perception of Realism in Composite Images

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code and data: www.eecs.berkeley.edu/~junyanz/projects/realism/
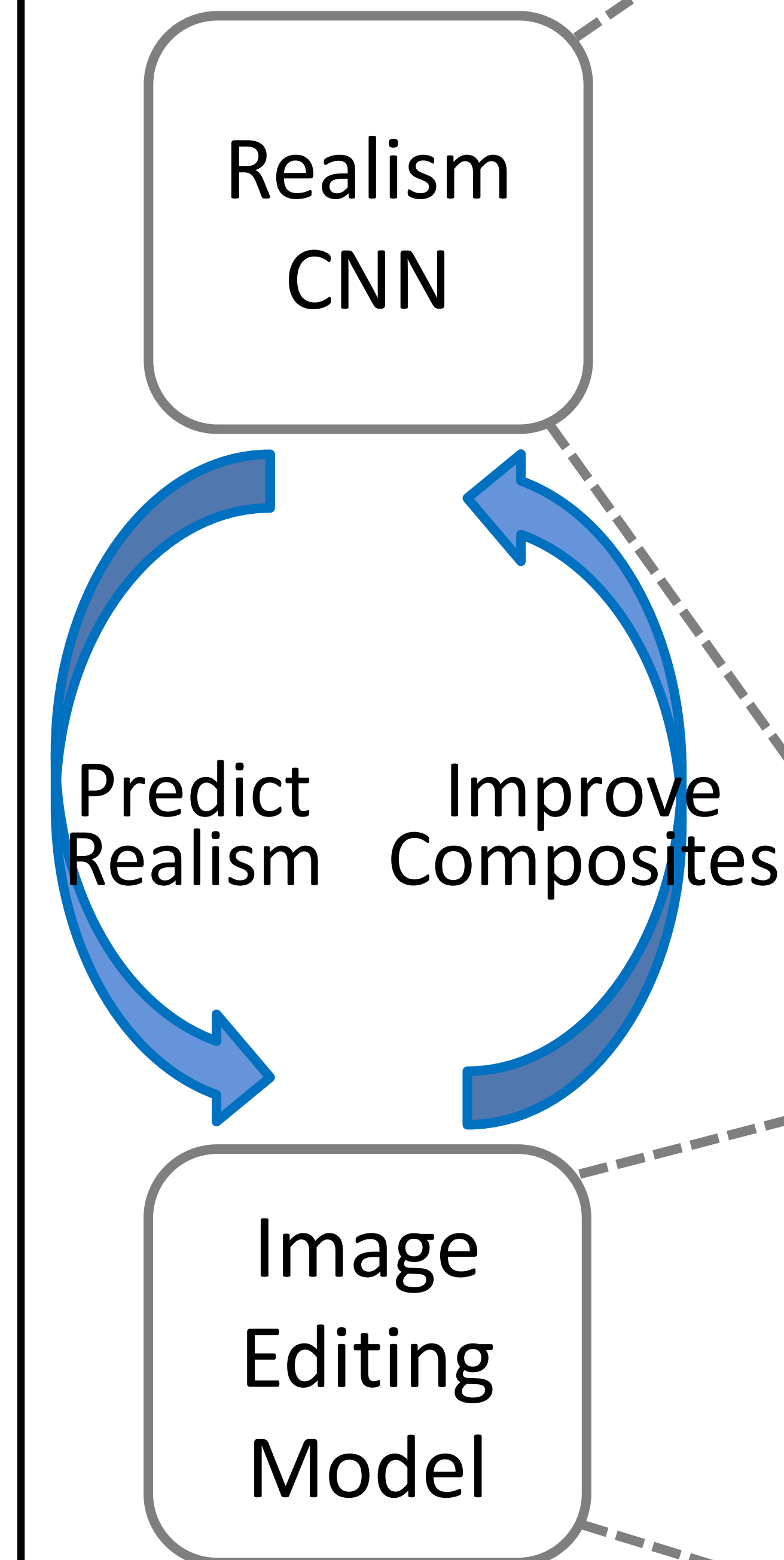
What is a Composite Image?

Foreground   +   Background   =   Image Composite

Which Photo Looks Realistic?

Natural   Realistic Composite   Unrealistic Composite

Photo Forensics   *Visual Realism*

Our Goals: (1) Learn a visual realism model **without** using human annotations. (2) Improve image compositing by optimizing visual realism.
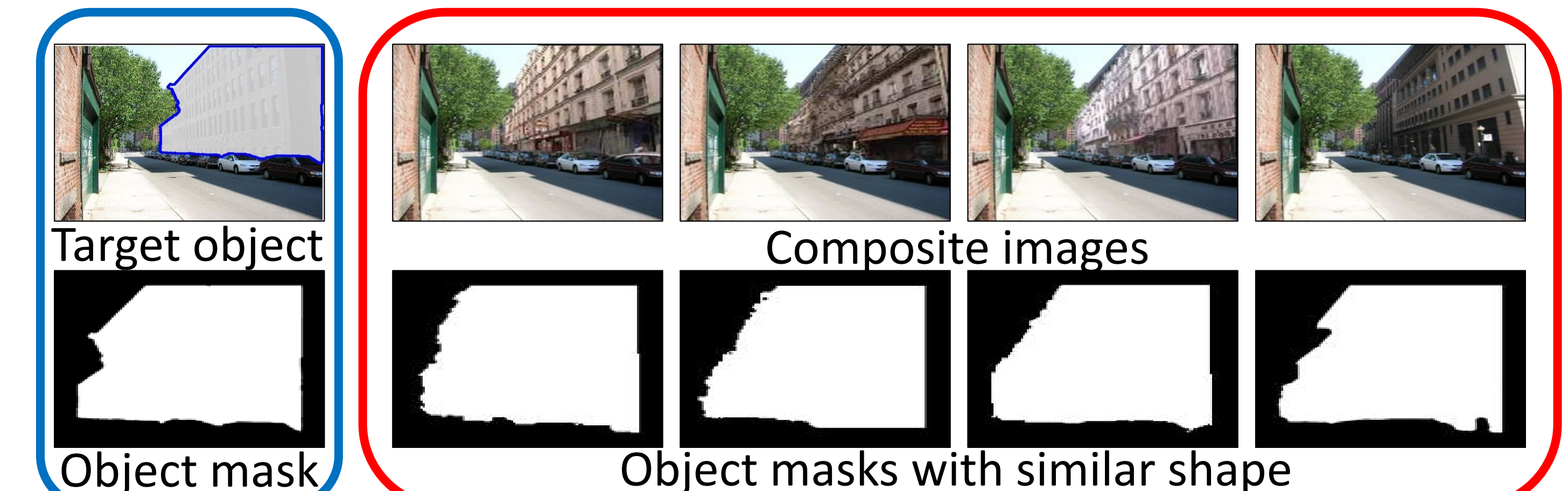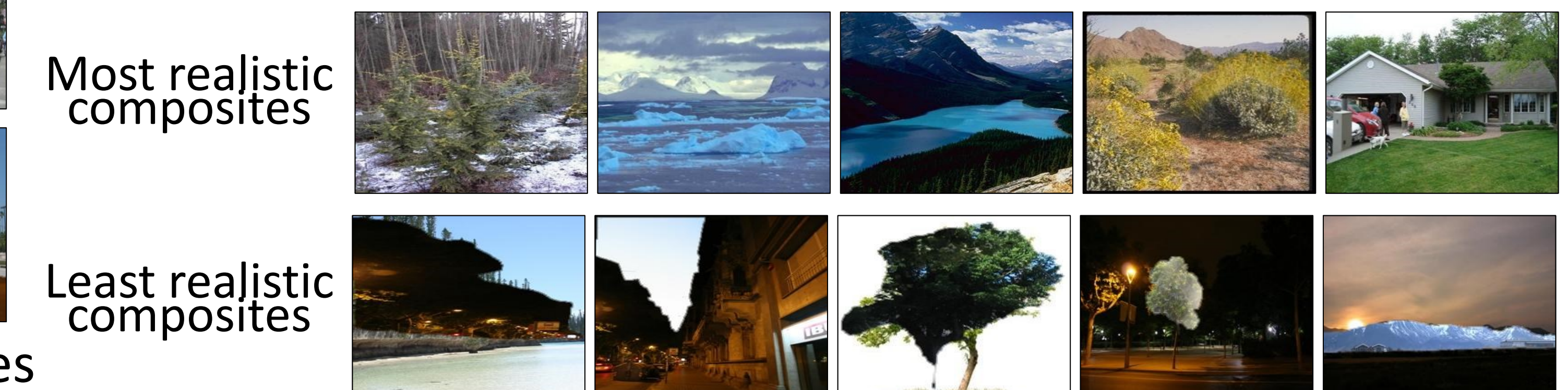
Overview

Realism CNN
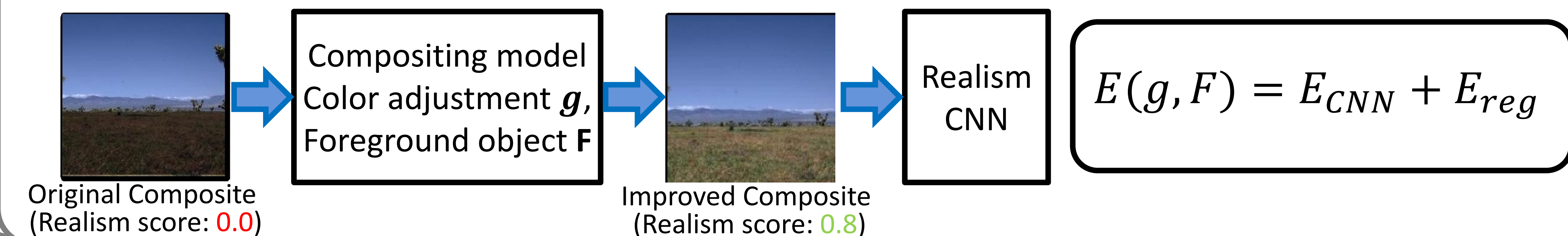
Predict Realism   Improve Composites

Image Editing Model

Realism Modeling

Natural photos

More Realistic

Image Composites

Automatically Generating Composites

Target object   Object mask

Composite images   Object masks with similar shape

Ranking of Negative Training Examples

Most realistic composites

Least realistic composites

Improving Object Compositing

Original Composite (Realism score: 0.0)

Compositing model Color adjustment g, Foreground object F

Improved Composite (Realism score: 0.8)

Realism CNN

$$E(g, F) = E_{CNN} + E_{reg}$$

Realism Prediction Results

Evaluation

Dataset (Lalonde and Efros [1])
- 360 realistic photos (natural images, realistic composites)
- 360 unrealistic photos

Area under ROC Curve

Methods without object mask	
Color Palette [2] (no mask)	0.61
VGG Net+SVM	0.76
RealismCNN	0.84
RealismCNN + SVM	**0.88**
Human	0.91

Methods using object mask	
Reinhard et al. [2]	0.66
Lalonde and Efros [1] (with mask)	0.81

- Indoor Dataset: 0.83 (RealismCNN)
- Object Proposals vs. Annotated Segments: 0.84 vs. 0.88 (with SVM)

Visual Realism Ranking

Least Realistic   Most Realistic

Snowy Mountain

Highway

Ocean
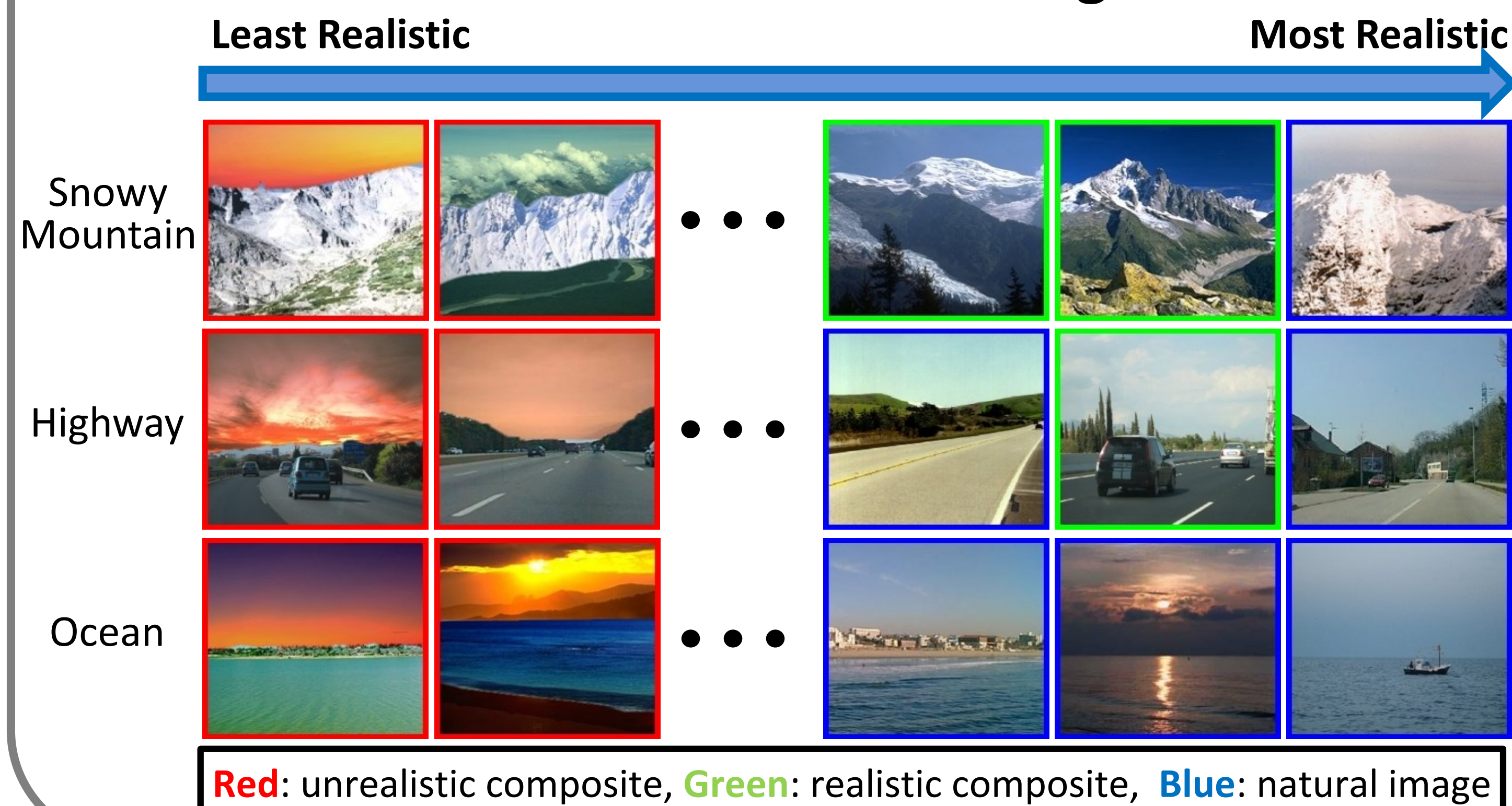
Red: unrealistic composite, **Green**: realistic composite, **Blue**: natural image

Reference

[1] J.-F. Lalonde and A. A. Efros. *Using color compatibility for assessing image realism.* In *ICCV* 2007.
[2] E. Reinhard, A. O. Akuyz, M. Colbert, C. E. Hughes, and M. OConnor. *Real-time color blending of rendered and captured video.* In *Interservice/Industry Training, Simulation and Education Conference* 2004.
[3] S. Xue, A. Agarwala, J. Dorsey, and H. Rushmeier. *Understanding and improving the realism of image composites.* SIGGRAPH 2012.

Optimizing Color Compatibility

Unrealistic

Natural

Object mask   Cut-n-paste   *Lalonde et al.[1]*   *Xue et al. [3]*   Ours
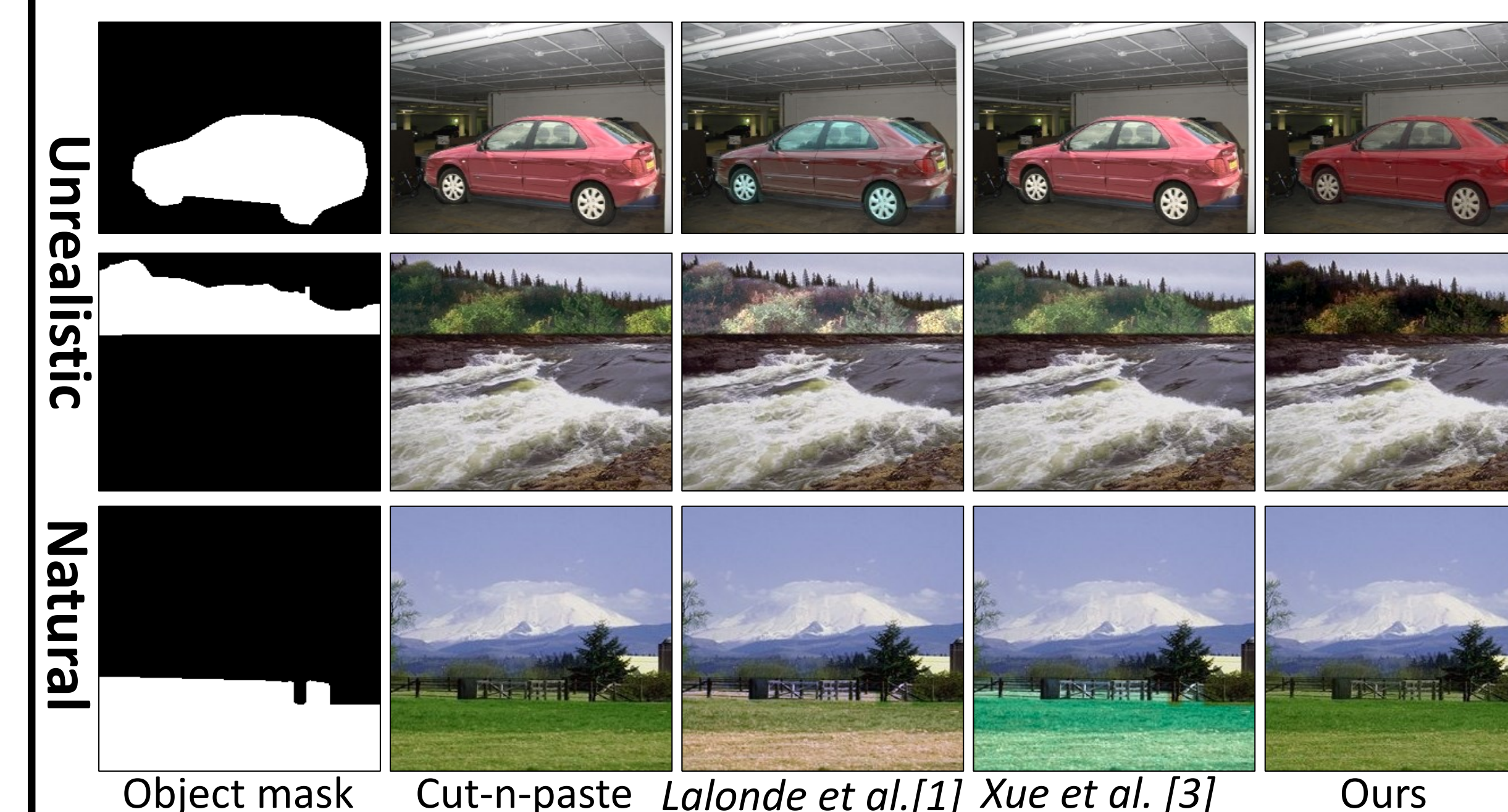
Evaluation (average Human ratings)

	Unrealistic Composites	Realistic Composites	Natural Photos
cut-n-paste	-0.024	0.263	**0.287**
[1]	0.123	-0.299	-0.247
[3]	−0.410	-0.242	-0.237
Ours	**0.311**	**0.279**	0.196

- Significantly improve the visual realism of unrealistic composites.
- Does not alter much color distribution of realistic composites and natural photos.

Selecting Suitable Objects

Best-fitting object selected by RealismCNN

Object with the most similar shape