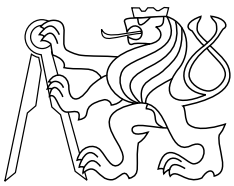
CENTER FOR
MACHINE PERCEPTION



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The CMP Facade Database
(Version 1.1)

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The CMP Facade Database

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Abstract

This report describes a dataset of facade images assembled at the Center for Machine Perception, which includes 606 rectified images of facades from various sources, which have been manually annotated. The facades are from different cities around the world and diverse architectural styles. Data origin, format and processing, annotation principles for classes *facade, molding, cornice, pillar, window, door, sill, blind, balcony, shop, deco*.

1 Introduction

The size of annotated training set containing regular structures is the limiting factor for learning of complex relations between objects of many classes. Because of only limited data sets are publicly available, we have set up a new data set, which is sufficiently large for learning, diverse in architectural styles and allows to describe more general relative locations of objects (overlapping, nesting).

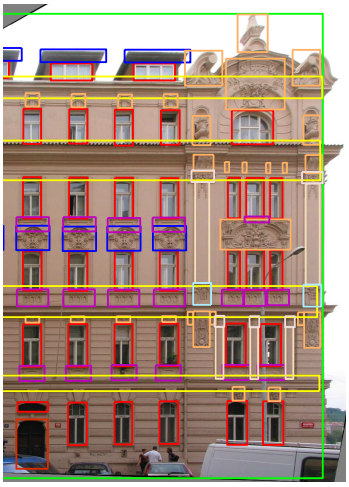
2 Image Data

Our datasets originates from different sources, details are provided in the following sections.

Images were rectified with a method based on estimation of vanishing points from lines detected in the image, and suitably cropped afterward (does not apply to already rectified adopted images).

2.1 CMP-Prague

Newly presented images acquired by CMP in Prague.



Location Prague, Czech Republic

Date 2007

Camera Canon G2

Resolution ~6 MPx

Size 213 images

Source J.Šochman, R.Šára (CMP)

2.2 CMP-World

Newly presented images acquired by CMP worldwide.

Location Bratislava, Buenos Aires, Frankfurt, Graz, London, Ostrava, Rome, Znojmo

Date 2007-2009

Camera Various

Resolution ~6 MPx

Size 99 images

Source J.Šochman, R.Šára (CMP)

2.3 ZuBuD

Images were adopted as a subset of unannotated Zurich Building Database.

Location Zurich, Switzerland

Date 2003

Camera ?

Resolution ~0.3 MPx

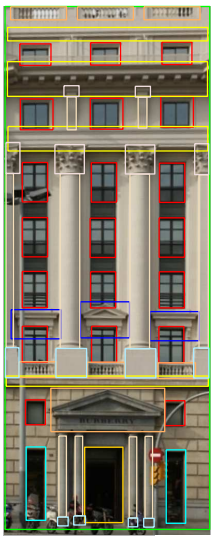
Size 177 images

Source H. Shao, T. Svoboda and L. Gool (ETH) [1]

http://www.vision.ee.ethz.ch/showroom/zubud/

2.4 ECP-World

Images were adopted as a subset of unannotated part of the Ecole Central Paris datasets.



Location Barcelona, Greece, Budapest, USA

Date 2010

Camera ?

Resolution ~0.6 MPx

Size 177 images

Source O. Teboul (ECP) [2]

http://vision.mas.ecp.fr/Personnel/teboul/data.php

3 Annotations

In this dataset *image annotation* is a set of rectangles scope with assigned class labels. Such rectangles are limited by the image scope in size and position, but otherwise they are allowed to overlap. The annotation do not necessarily explain the entire images, only objects of classes of interest are labeled. The unexplained part of the image is considered a **Background**.

3.1 Object classes

Dataset contains definitions for basic classes and sub-classes specified below.

Facade bounding box for a single plane wall, from pavement to roof, only complete facades are labeled, as if there is no occlusion by cars or others

Window entire glass area including borders, subtypes according to subdivision of window panes; all visible windows are annotated even if not within *Facade.*

Blind any functional obstacle to light on the window, both open or closed

Cornice decorative (raised) panel above the window

Sill decorative (raised) panel or stripe under the window

Door entrance

Balcony including railing, overlap with window when glass is visible behind

Deco any bigger piece of original art, paintings, reliefs, statues, when no other class is applicable

Molding horizontal decorative stripe across the facade, possibly with a repetitive texture pattern

Pillar vertical decorative stripe across the facade, possibly with a repetitive texture pattern, terminators (cap, base) are labeled separately

Shop shop windows, commercials, signs

3.1.1 Z-Order

While overlapping of object is allowed, we also sort the classes according to depth levels (Z-Order) in which the appear in the image. Rendering pixel-wise label map is then possible by sequentially painting elements according to their class labels and this order.

1. Background
2. Facade
3. Molding
4. Cornice
5. Pillar
6. Window
7. Door
8. Sill
9. Blind
10. Balcony
11. Shop
12. Deco

3.2 Principles

- All object annotations have *rectangular* shape.
- *Overlaps* are allowed.
- *Nesting* principle should be kept where applicable, i.e. windows inside a facade.
- Stretching of *stripes* should be to the maximal meaningful extend, i.e. side to side.

- Objects are annotated if they are not *occluded* by more than 33% of their area. Occlusion means that appearance of object borders or contents is substantially different from the expected appearance.
- The rectangle does not respect occlusions, it should reflect the occluded *reality* as much as possible. At least two opposite corners must be visible, or less if their position can be assumed from symmetry.
- Objects are annotated only on the major (rectified) plane.
- The major facade should be always labeled, additional *facades* only if their substantial part is visible.

3.3 Formats and Software

Annotation was performed in a custom tool for Matlab, which uses a single database file to store all annotations. Annotations are exported to the formats below.

3.3.1 XML format specification

Tag hierarchy and description:

`object` elements in a list

- `points` rectangle position
  - `x` relative coordinates (float[2])
  - `y` relative coordinates (float[2])
- `label` internal class index (integer)
- `labelname` class name (string)
- `flag` is representative example (boolean)

Example:

```
<object>
        <points>
        <x> 0.0821 </x>
                <x> 0.6947 </x>
                <y> 0.4286 </y>
```

```
            <y> 0.8616 </y>
        </points>
        <label> 1 </label>
        <labelname> facade </labelname>
        <flag> 1 </flag>
    </object>
    ...
```

3.3.2 PNG format specification

Objects are rendered into a single image according to the Z-order specified in Sec. 3.1.1. Image format is 8-bit indexed color with values according to the `label` value, optionally with a "jet" color map (palette), see Fig. 1.

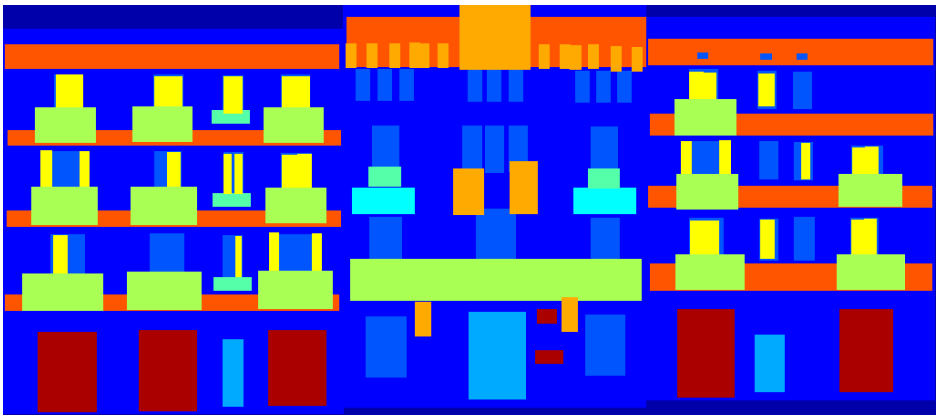


Figure 1: Annotation rendered in PNG format.

4 Datasets

Currently we provide two datasets based on the degree of regularity present in the facades:

CMP-base planar facades with dense/strong regularity

CMP-extended irregular, non-planar and sparse facades or images with substantial occlusion from vegetation etc.

Total numbers for individual datasets are presented in Tab. 1, which also provides comparison with previsous datasets.

Dataset	*Images*	*Objects*	*Classes*	*Avg. obj/im*	*Source*	*Main Author*
CMP-base	378	32861	12	88	CTU	R.Tyleček
CMP-extended	228	18870	12	82	CTU	R.Tyleček
Totals	*606*	*51731*				
ECP-Monge [2]	109	?	8	?	ECP	O.Teboul
eTrims-8 [3]	60	1702	8	28	UBonn	F.Korč
Totals	169					

Table 1: Statistics for current annotated datasets

5 Acknowledgment

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References

[1] T. S. Hao Shao and L. V. Gool, "Zubud - zurich buildings database for image based recognition," Tech. Rep. 260, April 2003. [Online]. Available: http://www.vision.ee.ethz.ch/showroom/zubud/index.en.html

[2] O. Teboul, I. Kokkinos, L. Simon, P. Koutsourakis, and N. Paragios, "Shape grammar parsing via reinforcement learning," in *Proc. CVPR*, Colorado Spring, USA, 2011.

[3] F. Korč and W. Förstner, "etrims image database for interpreting images of man-made scenes," Tech. Rep. TR-IGG-P-2009-01, March 2009. [Online]. Available: http://www.ipb.uni-bonn.de/projects/etrims_db/