Shape and Moment Invariants Local Descriptor for Structured Images

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Abstract

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Keywords: image mathching, shape descriptors, moment invariants,

1   Introduction

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Figure 1: "Is it the same object or scene?" Matching two images under different transformation using local interest regions detected by MSER.
Top image pair (scale and viewpoint): SURF descriptor yields false negative (similarity score 0.096), while the proposed SMI descriptor - true positive (0.89).
Bottom image pair (blur): SURF gives false positive (0.27), while SMI - true negative (−0.11).

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Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton.Here goes the Introduc Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduc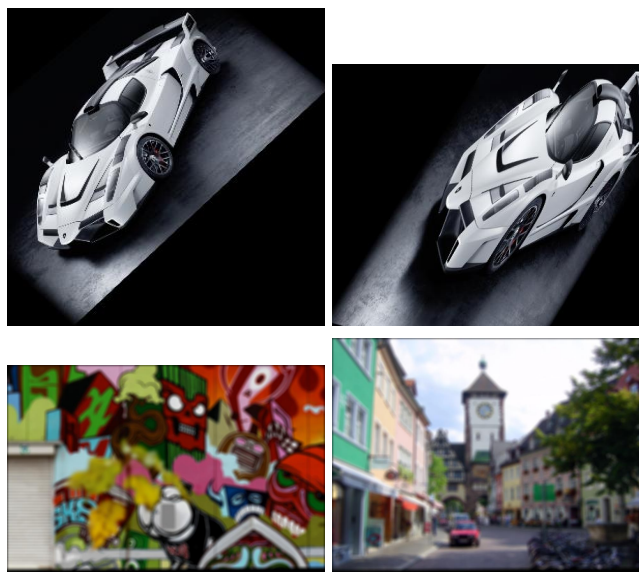iton. Here goes the Introduciton.Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton. Here goes the Introduciton.Here goes the Introduc

2 Related Work

2.1 Salient region detectors

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2.2 Region descriptors

State of the art in region descriptor

3 Image matching with Shape and Moment Invariant descriptor

We propose a set of several Shape and Moment Invariants (SMI) to encode each salient region into a feature vector (descriptor) used for the region matching. The SMI descriptor contains two parts: *simple shape invariants* and *moment invariants*.

$$SMI_i = \{S_i, M_i\} \tag{1}$$

3.1 Simple shape invariants

A binary shape of a region R_i can be described by a set of simple shape properties defined over the original shape or over the equivalent ellipse E_i with seond order moments the same as the region. These properties are: the region's area a_i, the area of the region's covex hull a_i^c, the length of the major and minor axes of E_i, μ_i and ν_i and the distance between the foci of the ellipse ϕ_i.From these basic properties, a set of affine invariants are defined in Table 1.

Invariant	Definition	Description
Relative Area	$\tilde{a}_i = a_i/A$	region's area normalized by the image area A
Ratio Axes Lengths	$r_i = \nu_i/\mu_i$	ratio between E_i minor and major axes lengths
Eccentricity	$e_i = \phi_i/\mu_i$	$e_i \in [0,1]$ (0 is a circle, 1 is a line segment.)
Solidity	$s_i = a_i/a_i^c$	proportion of the convex hull pixels, that are also in the region.

Table 1: Simple shape invariants.

The simple shape invariants part of SMI_i is

$$S_i = \{\tilde{a}_i, r_i, e_i, s_i\} \tag{2}$$

3.2 Moment invariants

3.3 Matching

My Paragraph: This is a paragraph.

4   Performance Evaluation

4.1   VGG dataset

The performance results on the VGG dataset are summarized in Table 2.

Det. + descr.	TP	TN	FP	FN	Acc.	Prec.	Recall
MSER + SURF	128	428	4	16	0.965	0.969	0.889
MSER + **SMI**	122	430	2	22	0.958	0.98	0.847
BIN + SURF	122	426	6	22	0.951	0.953	0.847
BIN (All) + **SMI**	84	432	0	60	0.89	1	0.58
BIN (Largest) + **SMI**	112	424	8	32	0.93	0.93	0.77

Table 2: Performance of salient region detectors and descriptors on the VGG dataset.

4.2   OxFrei dataset

The performance results on the VGG dataset are summarized in Table 3.

Det. + descr.	TP	TN	FP	FN	Acc.	Prec.	Recall
MSER + SURF	3309	28848	2904	660	0.90	0.53	0.83
MSER + **SMI**	2957	31162	590	1012	0.95	0.83	0.74
BIN + SURF	2513	28198	3554	1456	0.85	0.41	0.63
BIN (All) + **SMI**	1275	31298	454	2694	0.91	0.73	0.32
BIN (Largest) + **SMI**	2079	28474	3278	1890	0.85	0.38	0.52

Table 3: Performance of salient region detectors and descriptors on the OxFrei dataset.

5   Conclusion

A   VGG dataset matching results

B   OxFrei dataset matching results

References

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