

## 1. INTRODUCTION

### Motivation

- LBP is one popular texture feature, but fails to capture the complete intensity order information.
- Existing intensity order based methods do not address the grayscale inversion problem.

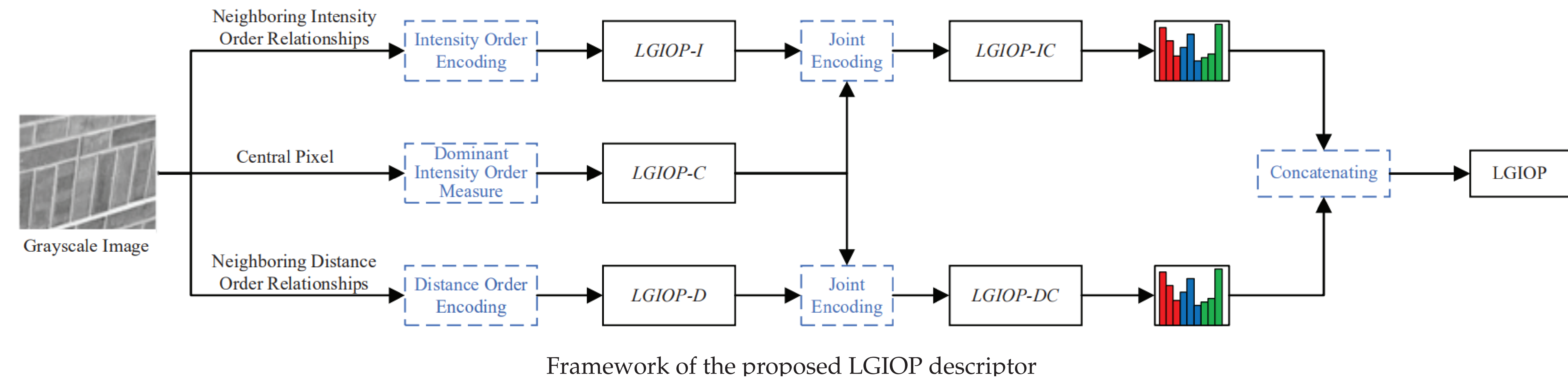


Four pairs of images captured under inverse grayscale changes

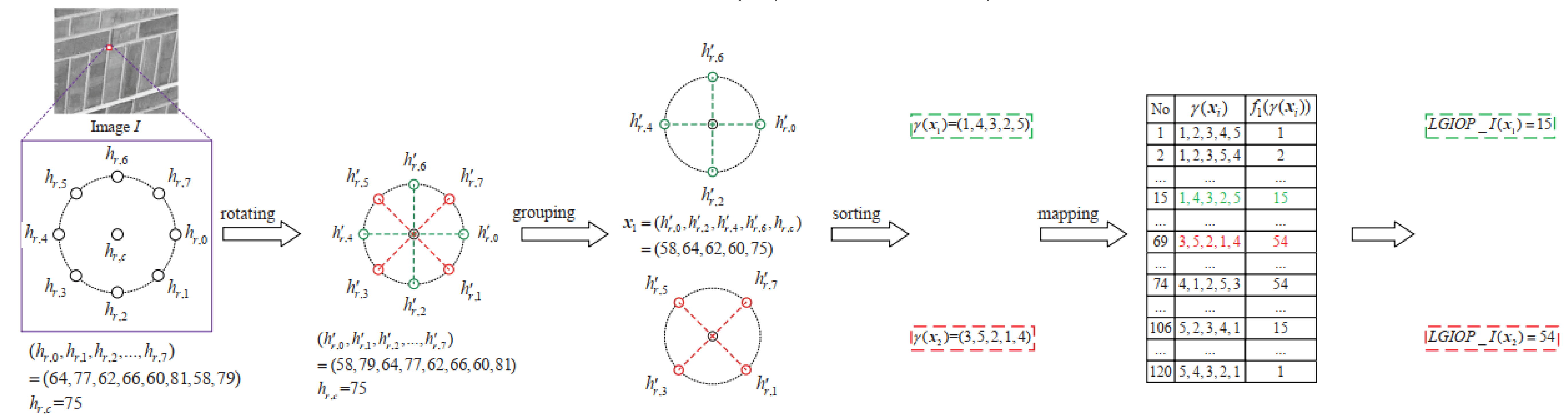
### Contributions

- We propose local grouped invariant order pattern (LGIOP) for grayscale-inversion and rotation invariant texture classification.
- LGIOP is a histogram representation which jointly encodes neighboring order information and central pixels.
- We propose two order encoding methods, i.e., intensity order encoding and distance order encoding.
- Experiments for texture classification show that the proposed LGIOP descriptor is robust to (linear or nonlinear) grayscale inversion and image rotation.

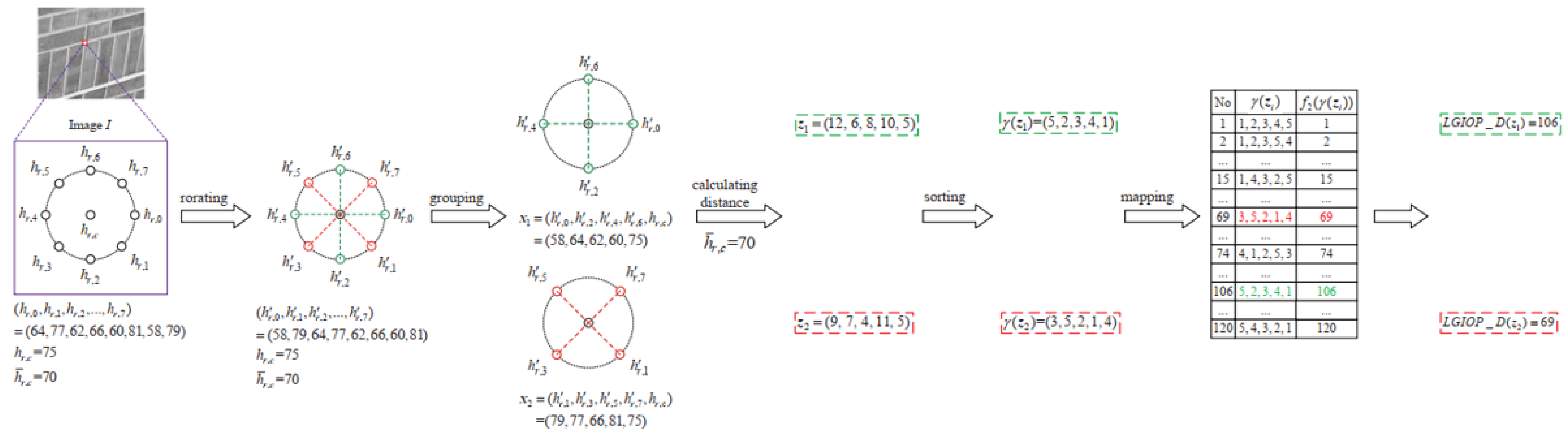
## 2. PROPOSED METHOD



Framework of the proposed LGIOP descriptor



(1) The LGIOP-I operator



(2) The LGIOP-D operator

## 3. EXPERIMENTAL RESULTS

CLASSIFICATION ACCURACY (%) ON THE OUTEX-TC10 DATABASE.

	Linear grayscale-inversion changes				Nonlinear grayscale-inversion changes			
	r=1, P=8	r=2, P=16	r=3, P=24	three scales	r=1, P=8	r=2, P=16	r=3, P=24	three scales
LBP [4]	29.42	32.13	44.08	39.98	29.40	32.14	44.09	40.63
LTP [5]	12.95	17.81	21.45	21.37	14.24	29.51	43.67	36.56
CLBP [6]	20.48	24.03	24.25	24.49	18.13	22.45	24.15	22.99
GLBP [11]	50.34	77.45	93.39	—	48.23	76.43	92.79	—
LGP [12]	60.48	87.86	89.35	94.58	54.40	82.91	83.88	91.27
NRLBP [14]	38.63	75.36	86.61	89.66	38.52	74.87	86.15	89.48
CGRI-LBP [15]	85.43	96.90	98.02	98.15	73.26	94.58	96.80	96.41
SLGP [13]	97.79				95.60			
MRELBP [10]	17.06				16.30			
LGONBP [21]	24.66				25.39			
LGIOP	<b>88.44</b>	<b>98.44</b>	<b>99.04</b>	<b>98.85</b>	<b>83.54</b>	<b>97.01</b>	<b>98.05</b>	<b>98.05</b>

CLASSIFICATION ACCURACY (%) ON OUTEX-TC12 (TL84).

	Linear grayscale-inversion changes				Nonlinear grayscale-inversion changes			
	r=1, P=8	r=2, P=16	r=3, P=24	three scales	r=1, P=8	r=2, P=16	r=3, P=24	three scales
LBP [4]	24.26	31.77	42.50	39.34	24.28	31.71	42.69	38.91
LTP [5]	22.48	25.63	32.47	37.99	12.92	29.56	42.78	35.32
CLBP [6]	17.79	22.56	23.17	22.12	17.15	22.64	23.63	23.15
GLBP [11]	45.99	74.59	90.43	—	41.75	72.94	89.32	—
LGP [12]	51.11	70.30	78.47	78.47	41.78	63.89	67.52	71.08
NRLBP [14]	32.57	64.88	70.42	73.09	31.92	64.65	70.51	73.01
CGRI-LBP [15]	63.50	83.09	87.76	85.16	59.31	72.82	80.63	77.99
SLGP [13]	84.17				75.49			
MRELBP [10]	25.02				25.14			
LGONBP [21]	23.80				24.58			
LGIOP	<b>83.63</b>	<b>93.52</b>	<b>96.09</b>	<b>95.90</b>	<b>73.52</b>	<b>89.21</b>	<b>90.90</b>	<b>91.25</b>