TABLE 1b
Table 1 (cont.)

N	Name	Filename	MRF	LCM	FRD	GCE	S10H	S10V	S10C	S10S	S10VC	S11H	S11V	S11C	S11S	S21HA	S21HV	S21HO	Mean
36	Loose burlap 2	D103	96.9	100.0	100.0	100.0	78.1	100.0	100.0	96.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.3
37	Metal reflector sheet 1	Metal.0000	100.0	90.6	93.8	100.0	100.0	87.5	96.9	71.9	96.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.3
38	Metal reflector sheet 2	Metal.0002	100.0	96.9	100.0	100.0	84.4	59.4	93.8	75.0	100.0	100.0	96.9	96.9	100.0	100.0	93.8	100.0	93.9
39	Miscellaneous	ximage38	100.0	87.5	90.6	93.8	50.0	62.5	96.9	78.1	93.8	90.6	87.5	100.0	81.3	84.4	87.5	81.3	85.5
40	Netting	D34	93.8	100.0	96.9	100.0	100.0	93.8	90.6	71.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.9
41	Oriental grass fiber cloth 1	D76	87.5	43.8	81.3	90.6	84.4	96.9	50.0	78.1	84.4	71.9	100.0	96.9	100.0	90.6	96.9	87.5	82.2
42	Oriental grass fiber cloth 2	D79	84.4	96.9	87.5	96.9	93.8	93.8	56.3	40.6	100.0	100.0	100.0	100.0	100.0	100.0	96.9	100.0	89.4
43	Oriental straw cloth 1	D52	96.9	96.9	84.4	96.9	84.4	100.0	43.8	12.5	100.0	93.8	93.8	100.0	100.0	87.5	87.5	100.0	85.1
44	Oriental straw cloth 2	D53	65.6	93.8	96.9	100.0	100.0	100.0	100.0	90.6	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.9
45	Oriental straw cloth 3	D78	100.0	93.8	65.6	100.0	87.5	100.0	43.8	68.8	100.0	93.8	90.6	100.0	84.4	100.0	100.0	100.0	89.5
46	Oriental straw cloth 4	D80	75.0	75.0	71.9	100.0	84.4	56.3	65.6	15.6	90.6	87.5	100.0	96.9	100.0	100.0	93.8	96.9	82.7
47	Oriental straw cloth 5	D82	81.3	84.4	68.8	96.9	90.6	87.5	96.9	84.4	100.0	96.9	100.0	100.0	100.0	96.9	100.0	100.0	92.7
48	Pigskin	pigskin-1.1.11	100.0	89.1	57.8	59.4	18.8	26.6	64.1	45.3	82.8	40.6	48.4	62.5	37.5	68.8	67.2	60.9	58.5
49	No description	D92	84.4	96.9	93.8	84.4	68.8	62.5	87.5	71.9	96.9	90.6	96.9	59.4	81.3	96.9	90.6	96.9	84.2
50	Plastic bubs	plasticbubs-1.1.13	100.0	93.8	71.9	68.8	43.8	37.5	68.8	43.8	84.4	81.3	75.0	62.5	90.6	78.1	78.1	84.4	72.6
51	Pressed calf leather	calfleath-1.1.6	100.0	98.4	85.9	100.0	65.6	46.9	87.5	78.1	89.1	81.3	89.1	96.9	75.0	90.6	93.8	84.4	86.0
52	No description	D24	84.4	100.0	100.0	100.0	81.3	100.0	84.4	68.8	96.9	100.0	100.0	100.0	96.9	100.0	100.0	100.0	94.9
53	Pressed cork	D4	84.4	87.5	87.5	100.0	84.4	75.0	59.4	53.1	96.9	96.9	81.3	96.9	78.1	100.0	100.0	96.9	86.8
54	Raffia looped to a high pile	raffia-1.1.10	98.4	82.8	71.9	100.0	48.4	98.4	95.3	90.6	98.4	57.8	98.4	95.3	89.1	92.2	100.0	96.9	89.1
55	No description	D84	87.5	100.0	100.0	100.0	81.3	65.6	96.9	53.1	93.8	96.9	100.0	100.0	96.9	100.0	100.0	96.9	92.1
56	Raffia weave	D18	87.5	87.5	71.9	59.4	65.6	15.6	65.6	25.0	31.3	84.4	62.5	78.1	68.8	78.1	50.0	40.6	60.8
57	Reptile skin	D3	84.4	100.0	100.0	100.0	100.0	100.0	100.0	71.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.1
58	Rough wall	roughwall-1.5.3	100.0	100.0	78.1	96.9	93.8	81.3	100.0	100.0	90.6	100.0	81.3	93.8	96.9	96.9	100.0	96.9	94.3
59	Sand	sand-1.5.4	100.0	100.0	96.9	90.6	96.9	84.4	96.9	96.1	87.5	93.8	93.8	96.9	100.0	100.0	100.0	100.0	95.9
60	Stone	Stone.0005	100.0	100.0	46.9	90.6	96.9	90.6	96.9	84.4	78.1	93.8	96.9	100.0	100.0	96.9	100.0	100.0	92.3
61	Straw matting	D55	100.0	96.9	84.4	100.0	100.0	87.5	93.8	84.4	96.9	100.0	100.0	100.0	90.6	100.0	96.9	96.9	95.8
62	Straw rattan	Fabric.0000	100.0	100.0	84.4	90.6	71.9	59.4	93.8	100.0	93.8	90.6	93.8	96.9	100.0	87.5	96.9	96.9	91.6
63	Water	Water.0001	100.0	96.9	90.6	90.6	81.3	96.9	100.0	96.9	96.9	78.1	90.6	100.0	96.9	100.0	100.0	96.9	94.5
64	Water	Water.0006	96.9	96.9	84.4	93.8	90.6	71.9	90.6	96.9	81.3	93.8	84.4	90.6	93.8	93.8	96.9	96.9	91.2
65	Water 2	water-1.1.8	100.0	67.2	45.3	50.0	17.2	35.9	31.3	21.9	100.0	37.5	40.6	92.2	45.3	89.1	92.2	92.2	59.2
66	Wood grain	woodgrain-1.1.9	98.4	71.9	40.6	98.4	84.4	60.9	87.5	59.4	98.4	98.4	62.5	92.2	90.6	100.0	100.0	98.4	84.5
67	No description	D68	0.0	100.0	90.6	18.8	46.9	96.9	96.9	75.0	100.0	78.1	90.6	100.0	87.5	81.3	90.6	43.8	70.4
68	Woolen cloth	woolencloth-1.1.5	100.0	51.6	28.1	98.4	50.0	35.9	75.0	32.8	92.2	57.8	31.3	79.7	35.9	37.5	50.0	35.9	57.0
69	No description	D19	96.9	84.4	75.0	84.4	59.4	96.9	100.0	65.6	81.3	87.5	96.9	90.6	100.0	93.8	100.0	84.4	87.9
70	Woven aluminium wire	D6	100.0	100.0	96.9	100.0	100.0	100.0	100.0	71.9	100.0	100.0	100.0	100.0	96.9	100.0	100.0	100.0	97.4
71	Woven mating	D83	93.8	81.3	96.9	84.4	90.6	100.0	78.1	65.6	93.8	100.0	100.0	90.6	93.8	100.0	87.5	100.0	90.1
	Averaged rate		92.2	89.0	79.8	90.5	72.2	75.6	82.6	67.6	93.0	87.0	86.4	92.9	87.7	91.4	92.2	90.2	86.8
	Average post. prob.		0.918	0.877	0.742	0.905	0.690	0.740	0.808	0.627	0.927	0.858	0.862	0.923	0.870	0.908	0.915	0.897	0.842
	Number of features		11	5	4	12	9	9	9	7	16	9	11	10	9	12	11	12	

Nevertheless, an analysis of the table by rows can give us some clues. This can be found in the last column, which shows the average performance of all methods for each class. Some images are indeed well classified by every method, the extreme case being class 16 (French canvas) which, due to its regularity, is perfectly classified by all the methods. But, the converse is not apparent: The difficult images (those with a lower average classification rate) do not exhibit such lower rates with all the methods. The lowest mean rate is 56.98 percent, obtained by class 68 (woolen cloth), which is nevertheless perfectly classified by the MRF. Almost the same happens with class 48 (pigskin). But, others like class 67 or class 44 (oriental straw cloth 2) show the contrary behavior with respect to MRF and SSDs. This strongly suggests that each particular case is best-suited to some methods but, also, that a clever combination of some or even all of them might build an almost perfect classifier. Further consideration on combining methods and a deeper experimental study would be needed and are left open as future work.

7 Conclusions and Further Developments

New probabilistic descriptors have been proposed and studied in this paper. Their discriminatory ability has been evaluated with some synthetic shapes and textures. Their performance as texture features in texture classification has been studied. Note that, in these experiments only, the cumulative or probability distribution functions of the spatial size distributions have been used. Many other probabilistic summaries of spatial size distributions could be used, such as moments (marginal means and standard deviations or the variance-covariance matrix). These alternative descriptors could give better results depending on their concrete application.

The original image is compared with a family of transformations of it (a granulometry of the image) by means of the geometric covariogram. An alternative and promising possibility could be to compare different granulometries of the same original image. In the definition of spatial size distribution, the original image should be substituted with another granulometry. Obviously, some relationship between these granulometries would have to be imposed in order to have a probability distribution.

The composition of different granulometries based on openings has been considered. Each one uses a different structuring element. An important open question is the selection of the optimal combination and order of structuring elements for a given task. This tends to be the most serious concern when mathematical morphology is applied in a blind way: the choice of the structuring elements.