$Tab.\ 1\ Segmentation\ accuracy\ comparison\ among\ algorithms\ which\ are\ designed\ specifically\ for\ image\ segmentation\ problem$ 

			a			b			с		d		
		4	5	6	5	6	7	4	5	6	4	5	6
	mean	9334.51	9931.36	10297.63	7167.71	7431.76	7621.87	5687.32	5946.74	6142.66	10817.55	11422.29	11855.99
PSO	SD	11.86	33.49	52.51	15.77	33.55	40.82	5.18	9.08	13.21	2.29	12.96	35.7
	wilcoxon	-	-	-	-	-	-	J.16 -	-	-	-	12.90	-
						7479.82						11420.79	
ODGO	mean	9342.57	9965.36	10368.47	7187.87		7686.76	5692.16	5957.78	6155.86	10818.87	11429.78	11872.34
QPSO	SD	2.05	15.25	11.53	5.76	9.74	19.07	0.76	4.96	8.96	3.03	5.66	24.84
	wilcoxon	- 0240.12	- 0071.00	10274.2	7106.52		7,005,01		-		10010.6	- 11421.04	- 44000 74
	mean	9340.12	9971.89	10374.3	7186.53	7485.36	7695.31	5690.49	5957.55	6159.79	10819.6	11431.84	11900.74
CQPSO	SD	3.1	3.61	13.13	3.68	8.95	10.3	2.36	4.54	4.68	1.72	6.77	25.94
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	+
	mean	8665.85	8979.48	9246.93	6590.02	6755.81	6938	5513.35	5686.12	5803.32	10664.22	11140.23	11561.05
MPSO	SD	325.25	356.92	277.23	199.08	191.03	175.37	108.72	119.83	115.41	72.22	101.41	92.93
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	9332.16	9934.65	10315.18	7165.99	7447.18	7651.44	5682.4	5945.02	6135.57	10804.65	11401.54	11842.96
DE	SD	8.07	20.3	26.25	13.25	12.56	16.49	4.5	8.2	8.62	8.09	12.72	26
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	9337.99	9944.75	10330.61	7168.28	7454.94	7651.61	5686.91	5947.19	6142.93	10810.96	11407.38	11838.01
MRLDE	SD	4.78	15.54	20.31	8.25	13.94	18.5	3.6	6.84	7.42	5.11	9.2	20.31
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	9333.68	9936.41	10321.22	7164.57	7454.51	7644.73	5684.33	5941.49	6139.33	10806.69	11398.09	11839.24
SDE	SD	7.3	17.88	23.29	11.97	16.84	17.59	3.56	8.51	11.4	4.99	14.32	15.11
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	9342.02	9968.37	10368.25	7182.87	7481.11	7684.36	5690.49	5956.04	6156.6	10816.58	11425.95	11885.48
ABC	SD	2.71	4.89	7.91	4.13	6.21	8.53	2.01	3.64	3.44	2.63	4.77	18.93
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	8719.43	9637.98	10022.63	6945.38	6981.75	7177.54	5690.53	5361.43	5746.95	10816.9	11428.06	11890.51
MABC15	SD	2330.37	1789.73	1861.22	1289.73	1865.96	1918.29	2.11	1787.14	1535.94	2.4	4.82	21.27
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	9334.21	9949.29	10333.47	7176.43	7466.52	7413.98	5686.66	5948.31	6150.73	10809.37	11413.66	11853.65
I_ABC	SD	6.03	14.98	25.08	8.55	13.87	1376.83	2.81	6.28	5.83	4.68	10.14	18.42
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
ILTD	mean	9344.2	9973.14	10378.7	7188.16	7486.19	7697.53	5692.41	5961.42	6160.77	10820.42	11432.51	11891.11
_ABC	SD	0.15	1.09	7.85	2.71	6.01	7.75	0.04	1.77	4.69	1.2	2.97	22.72
	l		l	l					1	1	l	l	

		e			f				g		h		
		4	5	6	5	6	7	4	5	6	4	5	6
	mean	5292.15	5543.24	5651.97	15895.47	16736.79	17244.10	10728.62	11389.45	11759.68	23260.43	24547.01	25371.72
PSO	SD	6.95	15.60	58.89	14.40	233.59	173.97	17.19	40.99	92.71	0.17	1.76	10.60
	wilcoxon	-	-	-	-	-	-	-	-	-	+	+	-
	mean	5294.41	5547.50	5697.39	15903.51	16812.53	17383.57	10739.27	11433.64	11888.02	23258.69	24540.11	25358.21
QPSO	SD	3.62	15.97	15.55	5.14	23.51	52.36	3.32	21.02	18.20	6.29	5.59	22.96
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5295.60	5548.71	5704.48	15903.36	16821.96	17434.78	10735.95	11450.34	11900.42	23239.00	24502.68	25328.09
CQPSO	SD	0.00	16.72	16.59	5.17	27.75	38.43	3.55	10.62	7.52	40.37	96.56	111.95
	wilcoxon	=	-	-	-	-	-	-	-	+	-	-	-
MPSO	mean	5058.98	5188.65	5183.65	15035.72	15439.88	15860.55	9900.97	10318.80	10523.17	23148.18	24303.41	25014.48

	SD	137.85	284.87	257.21	487.72	819.38	584.74	438.89	347.20	337.66	71.25	122.54	206.98
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5294.77	5549.81	5694.87	15895.18	16786.55	17369.27	10720.90	11403.74	11839.66	23219.86	24426.38	25201.98
DE	SD	1.03	10.58	13.41	8.61	26.66	38.63	9.77	22.62	27.32	37.36	64.31	61.90
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5295.33	5552.03	5693.63	15898.14	16801.29	17375.24	10729.71	11418.42	11845.90	23238.55	24498.57	25286.43
MRLDE	SD	0.64	8.11	12.47	9.30	24.80	40.97	7.19	19.97	30.38	14.80	39.87	45.45
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5294.81	5548.02	5693.40	15886.42	16791.44	17366.99	10726.36	11406.29	11826.76	23223.94	24457.90	25255.86
SDE	SD	0.90	8.75	10.37	16.00	27.43	25.74	7.01	32.39	30.15	20.54	63.74	59.77
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5295.52	5558.71	5704.72	15903.13	16817.64	17422.42	10735.14	11442.40	11882.72	23252.80	24534.88	25347.13
ABC	SD	0.33	3.57	9.17	5.11	20.27	27.71	4.63	12.72	15.72	7.09	7.41	21.82
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
	mean	5295.60	5560.51	5429.20	15904.62	15990.09	14823.00	10739.11	10875.84	11296.73	23259.95	24538.74	25356.10
MABC15	SD	0.00	3.56	1245.56	2.25	3668.39	6226.93	2.84	2495.11	2591.67	0.62	6.20	18.34
	wilcoxon	=	-	-	-	-	-	-	-	-	-	-	-
	mean	5290.14	5545.78	5690.53	15883.23	16760.10	17330.51	10722.41	11415.72	11841.23	23241.14	24505.09	25269.05
I_ABC	SD	10.38	15.45	15.40	24.10	64.79	98.71	11.73	23.15	29.90	13.76	32.90	71.73
	wilcoxon	-	-	-	-	-	-	-	-	-	-	-	-
ILTD	mean	5295.60	5562.28	5714.75	15905.21	16834.42	17448.91	10740.19	11455.61	11899.84	23260.26	24545.09	25374.24
_ABC	SD	0.00	1.21	8.98	0.00	6.69	22.21	0.78	3.45	7.04	0.91	4.50	8.66



(a) ABC



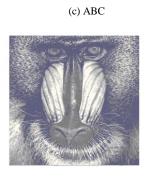


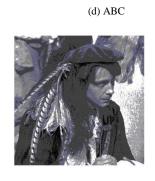


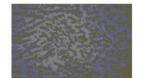




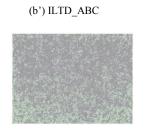
(b) ABC

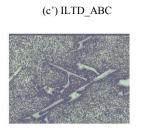


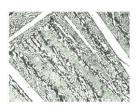




(a') ILTD\_ABC







(d') ILTD\_ABC



Fig. 2 Segmentation images, M-1=5

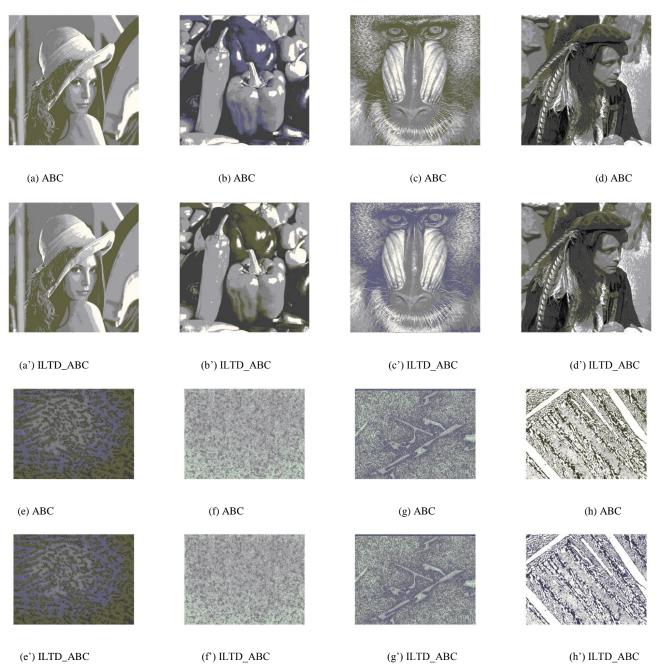


Fig. 3 Segmentation images, M-1=6

Tab. 2 Segmentation results for different algorithms with the maximum entropy based evaluation metric Kapur

				itation result					17		1		
Image	M-1		PSO	QPSO	CQPSO	MPSO	DE	MRLDE	SDE	ABC	MABC	I_ABC	ILTD_ABC
		mean	18.7641	18.7261	18.7658	18.3824	18.7467	18.7555	18.7408	18.7609	18.7653	18.6806	18.7659
	4	SD	3.42E-03	6.92E-02	3.69E-04	1.56E-01	8.90E-03	1.17E-02	3.15E-02	8.17E-03	1.09E-03	1.24E-01	1.24E-05
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
	5	mean	21.4537	21.4216	21.4709	20.8288	21.4226	21.4316	21.4017	21.4691	21.4772	21.4013	21.4814
a		SD	3.25E-02	5.70E-02	4.94E-02	2.19E-01	2.13E-02	2.95E-02	3.83E-02	1.57E-02	9.46E-03	6.01E-02	1.14E-02
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	23.9747	23.9117	23.9932	22.8903	23.8742	23.8818	23.8806	23.9941	24.0082	23.8573	24.014
	6	SD	3.97E-02	9.11E-02	8.71E-02	2.46E-01	6.72E-02	5.54E-02	9.29E-02	3.90E-02	1.82E-02	1.03E-01	2.03E-02
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	18.8062	18.8071	18.8078	18.5922	18.7929	18.8025	18.7971	18.8071	18.8071	18.8002	18.8083
1.	4	SD	3.16E-03	1.74E-03	7.79E-04	9.56E-02	6.04E-03	4.16E-03	5.78E-03	1.23E-03	9.77E-04	4.53E-03	9.37E-05
b		wilcoxon	-	-	-	-	-	-	-	-	-	-	
	5	mean	21.4551	21.4715	21.474	21.1018	21.4366	21.4453	21.4225	21.4691	21.4685	21.453	21.4746

		SD	2 73F-02	4 97F-03	4 68F-03	1.03F-01	1.73E-02	1.09F-02	1.56F-02	4 67F-03	3.33E-03	1.57E-02	9.15E-04
		wilcoxon	2.73E-02	4.97E-03	4.00E-03	-	1.73E-02	-	1.30E-02	4.07E-03	3.33E-03	1.37L-02	9.13E-04
		mean	23.8684	23.8895	23.9062	23.4241	23.8549	23.8628	23.8501	23.9164	23.9114	23.8976	23,9234
	6	SD	4.19E-02	4.09E-02	2.90E-02	1.78E-01	2.78E-02	3.21E-02	3.23E-02	1.25E-02	1.87E-02	1.87E-02	1.46E-02
		wilcoxon	-	-	-	-	-	-	-	-	-	-	1.4012-02
		mean	18.3177	18.2989	18.3428	18.1866	18.3726	18.3465	18.3638	18.3797	18.3905	18.3324	18.3295
	4	SD	5.66E-02	4.33E-02	6.41E-02	7.04E-02	3.09E-02	4.88E-02	4.54E-02	3.74E-02	2.83E-02	4.85E-02	6.20E-02
		wilcoxon	-	-	+	-	+	+	+	+	+	+	***************************************
		mean	21.1907	21.1262	21.2872	20.0786	21.2181	21.0209	21.2201	21.2714	21.2926	21.1972	21.1246
С	5	SD	1.20E-01	1.10E-01	5.67E-02	1.81E-01	5.03E-02	6.46E-02	5.72E-02	3.67E-02	1.28E-02	9.57E-02	1.64E-01
		wilcoxon	+	+	+	-	+	-	+	+	+	+	
		mean	23.76	23.6745	23.9254	23.1564	23.8415	23.8162	23.8132	23.9286	23.9399	23.8514	23.8541
	6	SD	1.54E-01	1.66E-01	1.04E-01	2.58E-01	6.24E-02	7.29E-02	7.19E-02	2.97E-02	3.02E-02	9.59E-02	1.71E-01
		wilcoxon	-	-	+	-	-	-	-	+	+	-	
		mean	19.6674	19.647	19.6703	19.1796	19.6211	19.6374	19.6182	19.6643	19.6647	19.5961	19.672
	4	SD	4.05E-03	3.54E-02	3.29E-03	1.60E-01	2.15E-02	2.26E-02	2.97E-02	7.90E-03	4.71E-03	6.16E-02	6.26E-04
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	22.5407	22.531	22.5537	21.8477	22.4357	22.4872	22.4472	22.5457	22.5483	22.4694	22.5634
d	5	SD	2.18E-02	3.68E-02	3.40E-02	2.62E-01	5.25E-02	3.15E-02	5.34E-02	1.87E-02	1.06E-02	6.10E-02	3.65E-03
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	25.1216	25.1099	25.2309	24.311	25.0286	25.0695	25.027	25.1957	25.1784	25.0995	25.212
	6	SD	1.00E-01	1.06E-01	3.55E-02	2.53E-01	9.12E-02	7.35E-02	7.87E-02	2.21E-02	3.47E-02	7.10E-02	2.47E-02
		wilcoxon	-	-	+	-	-	-	-	-	-	-	
		mean	13.8672	13.8617	13.871	13.5752	13.8475	13.8555	13.8554	13.8687	13.8694	13.1586	13.871
	4	SD	1.25E-02	1.46E-02	5.33E-15	1.31E-01	1.64E-02	1.50E-02	1.05E-02	2.43E-03	3.00E-03	3.02E+00	5.33E-15
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
	5	mean	15.7911	15.7973	15.8055	15.175	15.7512	15.7602	15.7506	15.7907	15.8156	14.2004	15.8272
e		SD	3.60E-02	3.65E-02	3.24E-02	1.85E-01	3.27E-02	2.62E-02	2.93E-02	2.95E-02	1.33E-02	4.73E+00	5.64E-03
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	17.5089	17.5048	17.5795	16.6145	17.444	17.4311	17.4468	17.5355	17.5434	17.4775	17.5658
	6	SD	7.00E-02	6.29E-02	1.32E-03	2.85E-01	4.61E-02	6.45E-02	5.39E-02	3.32E-02	2.96E-02	5.18E-02	2.38E-02
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	16.4191	16.4233	16.4169	16.129	16.3945	16.4069	16.403	16.4174	16.4209	15.5864	16.604
	4	SD	8.98E-03	4.15E-03	9.35E-03	1.33E-01	1.16E-02	1.26E-02	1.00E-02	8.02E-03	7.31E-03	3.58E+00	3.58E+00
		wilcoxon	10,0007	10.0075	10 0070	10 4106	10.0207	10.0510	10.0442	10,0002	10 0001	10.0002	10.007
· ·	5	mean SD	18.8886	18.8875	18.8979	18.4186	18.8396	18.8519	18.8442	18.8882	18.8891	18.8603	18.8967
f	3	wilcoxon	1.15E-02 -	1.19E-02 -	3.53E-03 +	1.85E-01 -	2.62E-02 -	2.56E-02 -	1.71E-02 -	1.22E-02 -	9.52E-03 -	1.67E-02 -	4.74E-03
		mean	21.1392	21.1153	21.1775	20.3914	21.0839	21.0911	21.0994	21.1639	21.157	21.1099	21.1714
	6	SD	3.70E-02	6.57E-02	5.18E-03	2.51E-01	3.48E-02	4.25E-02	3.34E-02	8.34E-03	1.48E-02	2.73E-02	9.30E-03
		wilcoxon	-	-	+	-	-	-	-	-	-	-	J.50E 05
		mean	16.8539	16.8539	16.8544	16.6649	16.8461	16.8484	16.8467	16.8538	16.853	16.8457	16.8551
	4	SD	1.36E-03	2.80E-03	6.72E-04	7.57E-02	5.72E-03	3.63E-03	3.68E-03	1.76E-03	2.15E-03	5.16E-03	3.33E-04
		wilcoxon					00		00		00	55	
g		mean	19.3389	19.3238	19.3615	19.0718	19.3003	19.3137	19.2917	19.3563	19.3591	19.2923	19.3685
	5	SD	2.60E-02	4.77E-02	3.89E-03	1.12E-01	2.76E-02	2.10E-02	2.41E-02	8.81E-03	7.00E-03	4.24E-02	6.47E-03
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
	6	mean	21.6094	21.6194	21.6913	21.3291	21.588	21.6156	21.584	21.6667	21.68	21.6002	21.7043
L	i .	j	İ	İ			İ		İ		İ	i l	l

		SD	6.94E-02	6.45E-02	4.45E-02	1.07E-01	3.09E-02	4.93E-02	4.65E-02	2.62E-02	2.53E-02	3.64E-02	1.53E-02
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	18.5989	18.5978	18.5995	18.5027	18.5909	18.5934	18.5904	18.5977	18.5978	18.5924	18.6002
	4	SD	1.83E-03	3.75E-03	9.11E-04	3.36E-02	3.87E-03	4.07E-03	4.07E-03	1.85E-03	1.75E-03	2.49E-03	5.99E-04
		wilcoxon	-	-	-	-	-	-	-	-	-	-	
		mean	21.4435	21.4474	21.4513	21.2256	21.4218	21.4275	21.4251	21.4466	21.4477	21.4365	21.4522
h	5	SD	8.05E-03	5.82E-03	2.48E-03	8.93E-02	1.14E-02	1.16E-02	9.05E-03	4.11E-03	2.90E-03	9.84E-03	2.31E-03
		wilcoxon	-	-	=	-	-	-	-	-	-	-	
		mean	24.1064	24.1253	24.1412	23.7784	24.0841	24.0982	24.0912	24.1356	24.1374	24.1164	24.1456
	6	SD	3.10E-02	2.69E-02	7.66E-03	1.46E-01	2.48E-02	1.92E-02	2.00E-02	9.25E-03	9.16E-03	1.20E-02	7.58E-03
		wilcoxon	-	-	-	-	-	-	-	-	-	-	