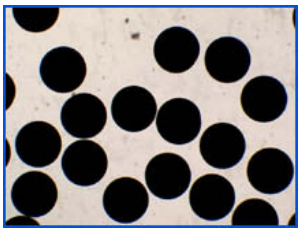
CLEMEX

IMAGE ANALYSIS REPORT

445

Tin balls analysis



Clemex Technologies Inc.

CLEMEX

IMAGE ANALYSIS REPORT

Part I: Specifications

Sample Description

One bottle containing Sn balls is submitted for analysis.

Purpose of Analysis

Demonstrate that Clemex Vision image analysis system can automatically discriminate, measure and classify 500 Sn balls. The tolerance range is 0.7 +/- 0.02 mm.

Apparatus

Image Analysis System:	Clemex Vision PE V3.5
Camera:	Sony DXC 950P
Microscope:	Nikon Optiphot-2
Illumination Type:	Transmitted light
Magnification:	25 X
Calibration:	0.00506 mm/pixel
Motorized Stage:	Marzhauser 40 x 40 mm
Joystick:	Clemex JS 2000

Procedure[1]

The Sn balls are spread over a special transparent plastic sheet and analyzed. A gray filter is applied to minimize dust detection. Sn balls are binarized into red bitplane using Gray Thresholding. Slightly touching balls are separated, overlapping ones are discarded and artifacts are eliminated using binary tools. Out of tolerance balls are transferred into different bitplanes for comparison purpose. Too small ones in blue and too big ones are in green.

Results[2]

Measurements of diameter (feret average) and aspect ratio are automatically performed over 440 fields. A guard frame is used avoiding the measurement of sectioned balls. Results are cumulated for automated statistics and graphics production. Final results are printed directly from Clemex Vision. Raw data is linked to his respective object and is exported in Excel format.

Discussion

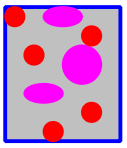
Once we found a way to hold the Sn balls with only a few of them touching, the analysis it self is straightforward. In the present case, all analyzed balls (1287 precisely) are below the tolerance range of 0.7 mm +/- 0.02 mm. Once the analysis is over, a sort on worst balls (aspect ratio and diameter) is performed. The mapping view tool is used to validate the 10 worst features and data is exported in Excel format[3].

[1] Images to follow the procedure are available in part II.
[2] Complete results are available in part III.
[3] Exported data is available in part IV.

CLEMEX

IMAGE ANALYSIS REPORT

Part II: Images



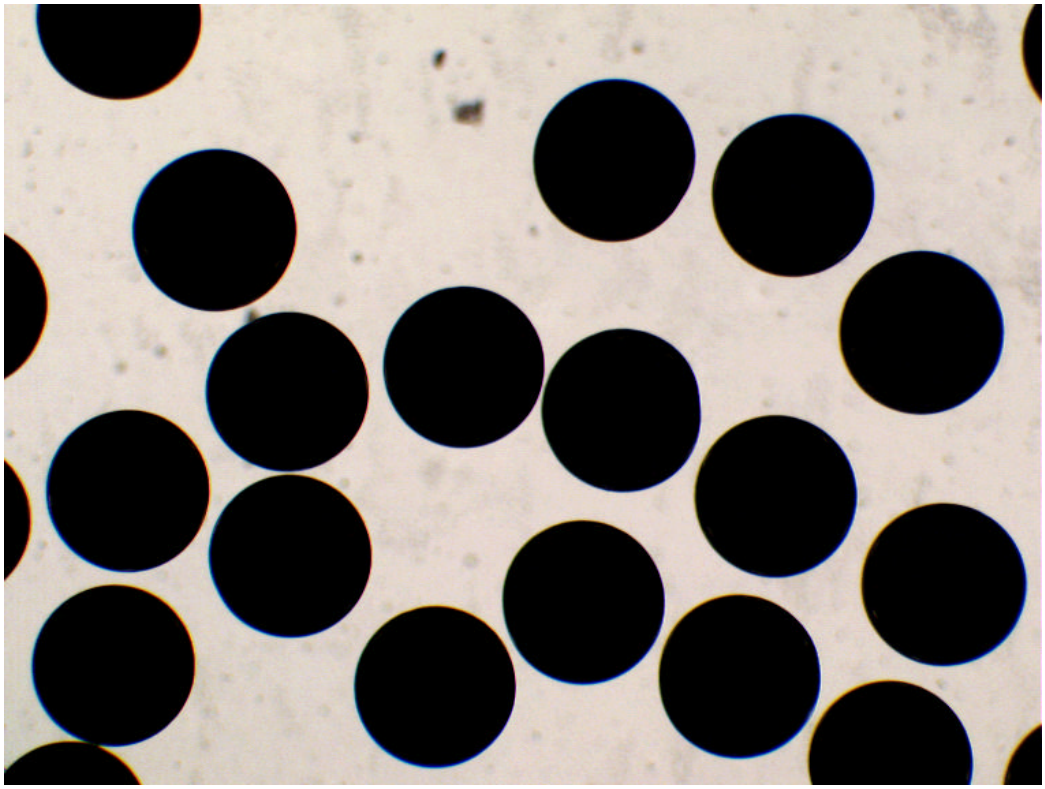


Figure 1: Original image at 25 x (0.00506 mm/pixel).

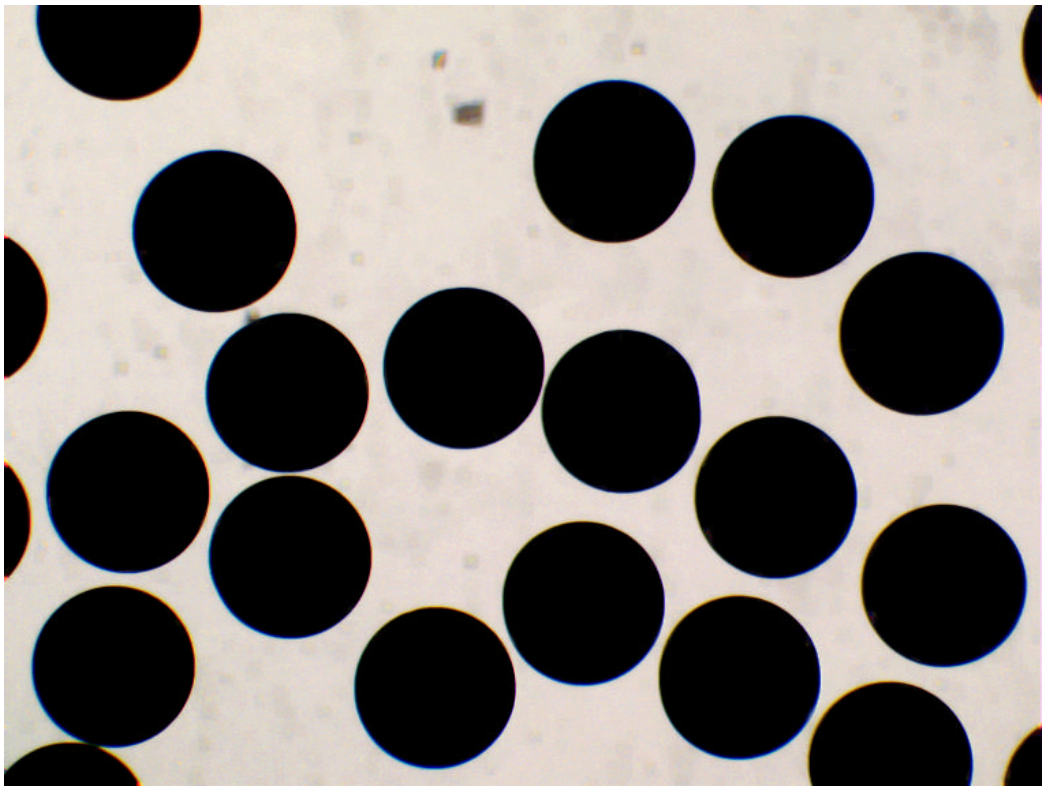


Figure 2: Gray closing significantly eliminates dust.

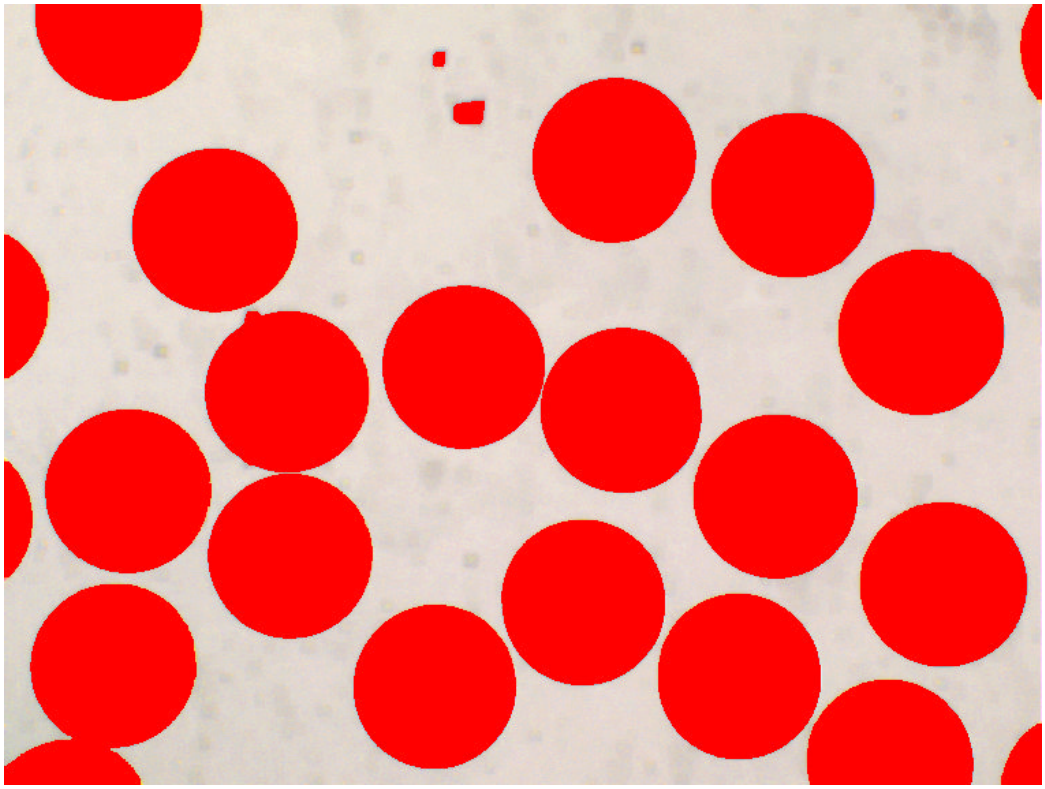


Figure 3: Binarization of Sn balls into red bitplane.

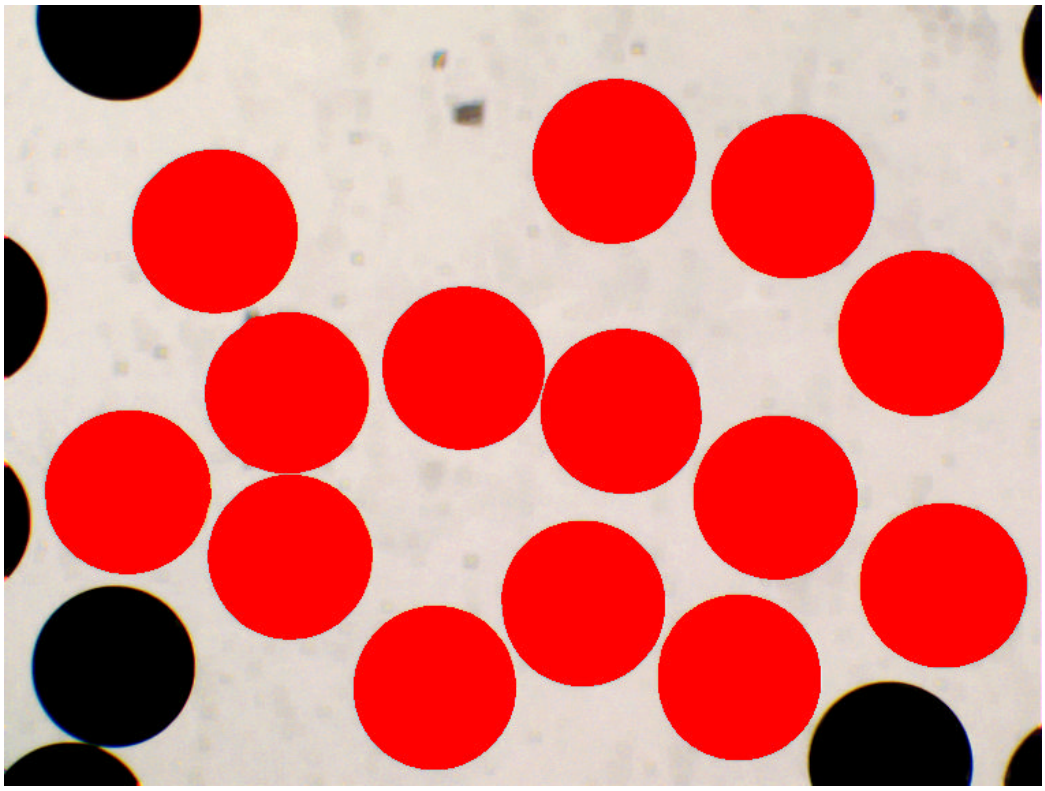


Figure 4: Artefacts are removed and touching balls separated using binary tools.

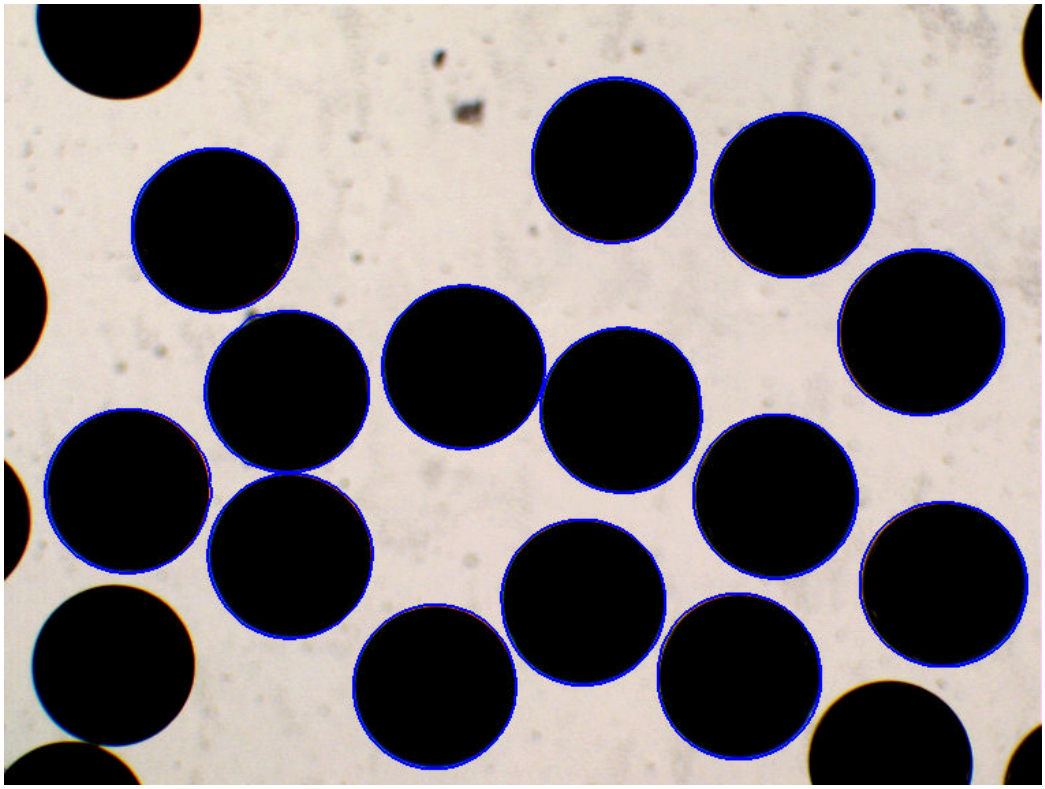
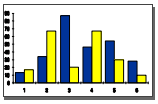


Figure 5: Blue bitplane in outline view overlaid against the original image. Blue bitplane corresponds to balls that are below the tolerance of 0.7 mm +/- 0.02 mm.

CLEMEX

IMAGE ANALYSIS REPORT

Part III: Results



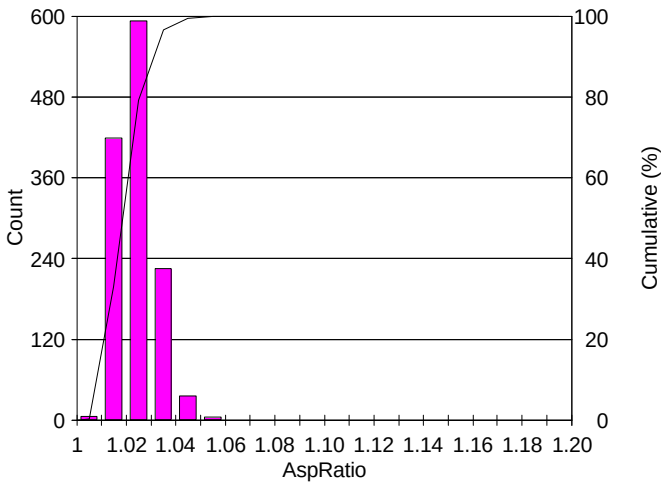
Clemex Vision Report

Organization:	**Clemex Technologies**	Date & Time:	**7/31/2001 12:04:02 PM**
Department:	**Quality Control**	Sample:	**Sample 1**
User:	**MS**	Description:	**Sn balls**

OBJM1 Count - AspRatio

Magn.: 25x Calib.: 0.0051 mm/pixel Bitplane: All

Chart



Values

AspRatio Intervals		Count	%	Cumul%
1	- 1.01	6	0.47	0.47
1.01	- 1.02	420	32.63	33.10
1.02	- 1.03	594	46.15	79.25
1.03	- 1.04	226	17.56	96.81
1.04	- 1.05	36	2.80	99.61
1.05	- 1.06	5	0.39	100
1.06	- 1.07	0	0	100
1.07	- 1.08	0	0	100
1.08	- 1.09	0	0	100
1.09	- 1.10	0	0	100
1.10	- 1.11	0	0	100
1.11	- 1.12	0	0	100
1.12	- 1.13	0	0	100
1.13	- 1.14	0	0	100
1.14	- 1.15	0	0	100
1.15	- 1.16	0	0	100
1.16	- 1.17	0	0	100
1.17	- 1.18	0	0	100
1.18	- 1.19	0	0	100
1.19	- 1.20	0	0	100

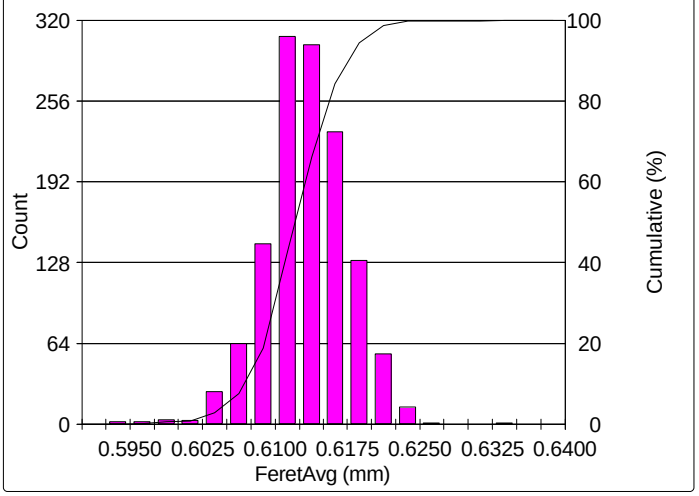
Statistics

Minimum:	1.01	
Maximum:	1.06	
Mean:	1.02	
Std Dev.:	7.54e-03	
Count:	1287	
Under:	0	
Over:	0	
Accepted:	100	%
Field Count:	440	
Field Area:	7.4311	mm²
Total Area:	3269.6752	mm²

OBJM1 Count - FeretAvg

Magn.: 25x Calib.: 0.0051 mm/pixel Bitplane: All

Chart



Values

FeretAvg Intervals (mm)		Count	%	Cumul%
0.5900	- 0.5925	0	0	0
0.5925	- 0.5950	2	0.16	0.16
0.5950	- 0.5975	2	0.16	0.31
0.5975	- 0.6000	4	0.31	0.62
0.6000	- 0.6025	3	0.23	0.85
0.6025	- 0.6050	26	2.02	2.87
0.6050	- 0.6075	64	4.97	7.85
0.6075	- 0.6100	143	11.11	18.96
0.6100	- 0.6125	308	23.93	42.89
0.6125	- 0.6150	301	23.39	66.28
0.6150	- 0.6175	232	18.03	84.30
0.6175	- 0.6200	130	10.10	94.41
0.6200	- 0.6225	56	4.35	98.76
0.6225	- 0.6250	14	1.09	99.84
0.6250	- 0.6275	1	0.08	99.92
0.6275	- 0.6300	0	0	99.92
0.6300	- 0.6325	0	0	99.92
0.6325	- 0.6350	1	0.08	100
0.6350	- 0.6375	0	0	100
0.6375	- 0.6400	0	0	100

Statistics

Minimum:	0.5946	mm
Maximum:	0.6338	mm
Mean:	0.6133	mm
Std Dev.:	0.0042	mm
Sum:	789.3366	mm
Count:	1287	
Under:	0	
Over:	0	
Accepted:	100	%
Field Count:	440	
Field Area:	7.4311	mm²
Total Area:	3269.6752	mm²

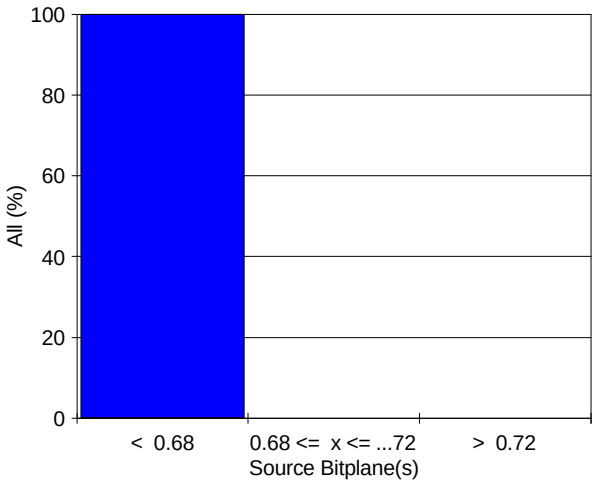
Clemex Vision Report

Organization:	**Clemex Technologies**	Date & Time:	**7/31/2001 12:04:02 PM**
Department:	**Quality Control**	Sample:	**Sample 1**
User:	**MS**	Description:	**Sn balls**

RELM6 Count %

Magn.: 25x Calib.: 0.0051 mm/pixel

Chart



Values

S. Bitplane(s)	All (%)
< 0.68	100
0.68 <= x <= 0.72	0
> 0.72	0

Statistics

Field Count:	440	
Field Area:	11.1672	mm²
Total Area:	4913.5550	mm²

CLEMEX

IMAGE ANALYSIS REPORT

Part IV: Raw Data

	BpName	Routine	Mag	Unit	Calib	MeasType	MeasCnt	FieldCnt	ObjCnt
	All	445	25x	Millimeters	0.005063	OBJ	5	440	1287

	FldNon	ObjIdn	Catn		FeretAvg mm	AspRatio
1	361	1061		4	0.607215	1.055085
2	404	1187		4	0.611147	1.054375
3	293	824		4	0.617075	1.052828
4	437	1289		4	0.617346	1.051320
5	364	1071		4	0.611802	1.050653
6	204	589		4	0.609493	1.049488
7	111	331		4	0.620513	1.048119
8	215	617		4	0.622278	1.047812
9	112	338		4	0.622379	1.047616
10	32	74		4	0.615123	1.046555
	277	770		4	0.616739	1.046029
	284	798		4	0.614228	1.045362
	179	509		4	0.615303	1.045138
	106	317		4	0.616818	1.043815
	244	686		4	0.617637	1.043466
	278	776		4	0.612147	1.043376
	404	1182		4	0.622417	1.043231
	377	1115		4	0.619631	1.043205
	192	546		4	0.603267	1.043010
	307	874		4	0.61014	1.042909
	53	126		4	0.618807	1.042856
	287	807		4	0.618242	1.042668
	30	69		4	0.616036	1.042498
	155	458		4	0.606371	1.042450
	330	961		4	0.617247	1.042330
	400	1174		4	0.61377	1.042315
	160	467		4	0.613681	1.042315
	126	370		4	0.617595	1.041835
	374	1102		4	0.612334	1.041785
	324	943		4	0.614984	1.041581
	143	421		4	0.613984	1.041386
	15	34		4	0.612622	1.041151
	290	812		4	0.608245	1.041026
	143	423		4	0.611521	1.040969
	359	1049		4	0.612779	1.040894
	303	853		4	0.603624	1.040851
	161	469		4	0.612848	1.040786
	16	37		4	0.6179	1.040476
	74	216		4	0.612643	1.040337
	194	557		4	0.614666	1.040329
	404	1186		4	0.611979	1.040192
	186	533		4	0.61472	1.039835
	383	1128		4	0.616115	1.039616
	76	228		4	0.615268	1.039614
	46	101		4	0.616203	1.039442
	389	1139		4	0.608266	1.039423
	214	613		4	0.611763	1.039280

Sort on aspect ratio.
The 10 first features are
the worst 10 balls in sphericity.

	BpName	Routine	Mag	Unit	Calib	MeasType	MeasCnt	FieldCnt	ObjCnt
	All	445	25x	Millimeters	0.005063	OBJ	5	440	1287

	FldNon	ObjIdn	Catn		FeretAvg mm	AspRatio
1	174	493		4	0.594632	1.029861
2	100	293		4	0.594681	1.019319
3	195	565		4	0.595245	1.020242
4	81	243		4	0.596068	1.026979
5	374	1104		4	0.598123	1.027214
6	208	597		4	0.599519	1.026043
7	184	529		4	0.599620	1.019817
8	89	253		4	0.599840	1.024474
9	272	763		4	0.600888	1.024005
10	120	359		4	0.601236	1.025011
	184	528		4	0.601936	1.017586
	299	838		4	0.602796	1.023968
	244	684		4	0.602917	1.024252
	173	492		4	0.603037	1.035083
	81	242		4	0.603162	1.03587
	369	1086		4	0.603254	1.015502
	192	546		4	0.603267	1.04301
	411	1201		4	0.603421	1.02606
	65	166		4	0.603561	1.018906
	303	853		4	0.603624	1.040851
	306	864		4	0.603707	1.024098
	45	98		4	0.603756	1.023715
	279	779		4	0.603927	1.018446
	301	848		4	0.604190	1.029004
	69	187		4	0.604303	1.018262
	190	543		4	0.604345	1.033
	189	541		4	0.604443	1.031932
	330	960		4	0.604448	1.027522
	106	316		4	0.604508	1.028494
	14	28		4	0.604522	1.033038
	311	894		4	0.604600	1.016841
	147	431		4	0.604627	1.029004
	56	139		4	0.604641	1.019747
	141	409		4	0.604679	1.021821
	316	910		4	0.604699	1.02696
	280	783		4	0.604717	1.026367
	155	457		4	0.604865	1.017662
	318	921		4	0.605295	1.037248
	119	356		4	0.605329	1.03587
	259	739		4	0.605371	1.010548
	245	687		4	0.605390	1.029545
	342	991		4	0.605471	1.015264
	74	213		4	0.605480	1.017487
	13	27		4	0.605489	1.035594
	275	768		4	0.605519	1.019969
	229	654		4	0.605522	1.021869

Sort on feret average.
The 10 first features are
the worst 10 balls in diameter.

CLEMEX

THE IMAGE ANALYSIS PEOPLE