

A hybrid Particle Swarm Optimization-Tuning Algorithm for the prediction of nanoparticle morphology from microscopic images

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Supplementary Information

Fig. S1 summarizes the basic steps involved in the prediction of the 3-dimensional structure from the 2-dimensional projections. A 3-dimensional aggregate is generated using FracVAL corresponding to preset morphological features. It is then projected onto a random plane, and various 2-dimensional features are extracted, which are then used as inputs for the PSO algorithm. The coordinates of the particle swarm are then updated for different morphological parameter values (N , D_f , k_f), and the 3-dimensional aggregates are generated using FracVAL. Several projections of each of these aggregates are used to obtain corresponding 2-dimensional features, and the fitness function is updated accordingly. The best fit structure corresponding to the lowest fitness function is the output from the hybrid algorithm, and the corresponding 3-dimensional properties are then calculated for comparison. The projection used in Fig. S1 contains an input aggregate in the blue color of 25 monomers with $D_f = 1.4$ and $k_f = 1.3$, and the predicted yellow-colored aggregate has $N = 25$, $D_f = 1.39$, and $k_f = 1.31$.

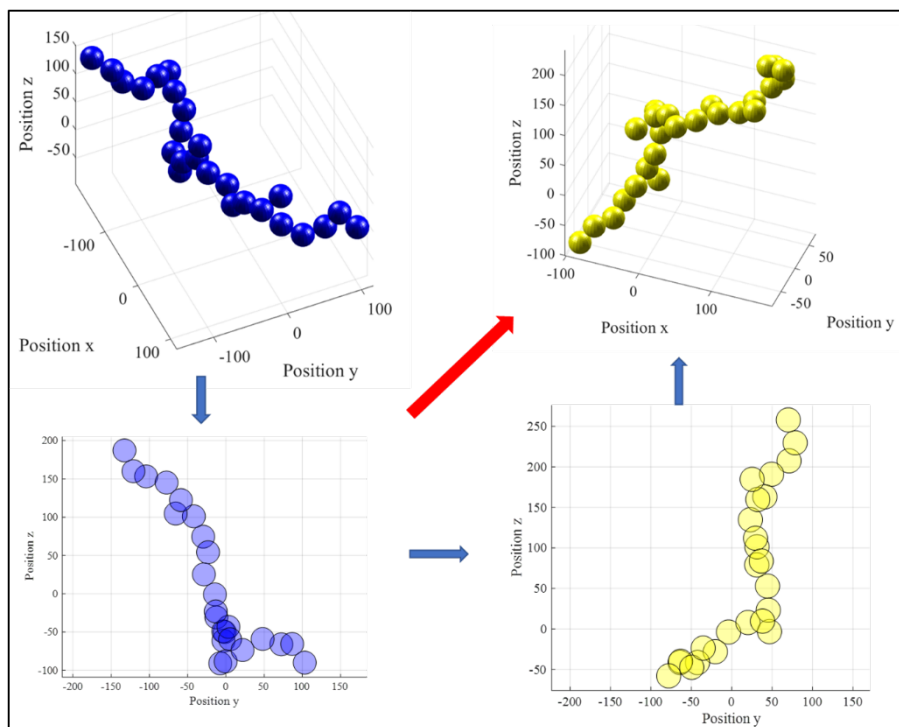


Fig. S1. Retrieval of the 3-dimensional structure of an aggregate from a 2-dimensional projection of an available aggregate generated as a test projection image.

Table S1. Fractal parameters of aggregates used for input projection and the best fit aggregate obtained (**Without D_{f2d}**) (symbol ‘I’ used as input and ‘O’ for the output values)

Case No.	Fractal parameters					
	$N(I)$	$D_f(I)$	$k_f(I)$	$N(O)$	$D_f(O)$	$k_f(O)$
1	25	1.4	1.3	25	1.50	1.16
2	25	1.6	1.3	25	1.45	1.65
3	25	1.8	1.3	23	1.89	1.32
4	25	2	1.3	20	1.88	1.55
5	25	2.2	1.3	23	2.41	1.15
6	25	2.4	1.2	23	2.46	1.18
7	100	1.6	1.3	97	1.46	1.77
8	100	1.8	1.3	106	1.85	1.33
9	100	2.0	1.3	103	1.94	1.42
10	100	2.2	1.3	100	2.38	1.19

Table S2a. 3-dimensional properties of aggregates used for input projection and the best fit aggregate obtained corresponding to the same fractal parameter sets (**Without D_{f2d}**)

Case No.	Fractal parameters			3-dimensional properties					
	$N(I)$	$D_f(I)$	$k_f(I)$	$R_h(I)$	$R_h(O)$	$PA(I)$	$PA(O)$	$R_{pa}(I)$	$R_{pa}(O)$
1	25	1.4	1.3	87.64	84.05	14230.87	13936.38	67.32	66.62
2	25	1.6	1.3	78.65	78.37	13496.49	13436.57	65.56	65.42
3	25	1.8	1.3	70.83	66.99	12654.08	11621.56	63.48	60.84
4	25	2	1.3	67.72	59.98	12255.46	9841.18	62.47	55.98
5	25	2.2	1.3	62.31	57.88	11409.47	10074.75	60.28	56.64
6	25	2.4	1.2	59.73	57.47	10741.19	9999.35	58.49	56.43
7	100	1.6	1.3	171.04	171.81	49811.36	48830.31	125.95	124.70
8	100	1.8	1.3	148.94	142.36	47242.54	46189.91	122.66	121.29
9	100	2.0	1.3	127.51	131.13	41901.50	42813.50	115.52	116.77
10	100	2.2	1.3	115.99	108.10	37834.63	35070.19	109.77	105.68

Table S2b. 3-dimensional properties of aggregates used for input projection and the best fit aggregate obtained corresponding to the same fractal parameter sets (**Without D_{f2d}**)

Case No.	Fractal parameters			3-dimensional properties					
	$N(I)$	$D_f(I)$	$k_f(I)$	$d_m(I)$	$d_m(O)$	$A_{13}(I)$	$A_{13}(O)$	$R_{g3d}(I)$	$R_{g3d}(O)$
1	25	1.4	1.3	141.76	139.44	4.5095	6.0420	123.31	115.40
2	25	1.6	1.3	135.89	135.54	4.2407	5.3934	94.42	97.21
3	25	1.8	1.3	129.70	123.89	5.6151	2.5776	76.64	67.08
4	25	2	1.3	126.91	113.30	2.5511	3.6344	64.79	57.52
5	25	2.2	1.3	121.30	113.71	2.6512	2.3468	56.42	50.69
6	25	2.4	1.2	117.41	113.21	2.5778	2.0652	51.93	48.87
7	100	1.6	1.3	280.86	279.11	3.6574	5.5943	226.09	232.59
8	100	1.8	1.3	262.99	246.30	3.7274	4.3153	167.05	159.50
9	100	2.0	1.3	239.13	243.23	3.9585	3.6711	131.06	136.04
10	100	2.2	1.3	246.30	212.92	2.4789	1.8699	107.39	95.85

Table S3a. 2-dimensional properties compared for the input projection and the best fit projection (Without D_{r2d})

Case No.	$N(I)$	$D_f(I)$	$k_f(I)$	$R_{g2D}(I)$	$R_{g2D}(O)$	$L_{max}(I)$	$L_{max}(O)$	$A_{proj}(I)$	$A_{proj}(O)$
1	25	1.4	1.3	112.6	112.4	397.31	402.87	15782.76	15660.94
2	25	1.6	1.3	83.76	82.87	282.79	280.68	11818.82	11924.79
3	25	1.8	1.3	64.85	63.33	180.29	191.76	10845.73	11293.17
4	25	2.0	1.3	50.19	49.93	170.287	171.17	9798.83	9843.89
5	25	2.2	1.3	40.28	40.27	135.12	135.07	9008.66	8983.6
6	25	2.4	1.2	38.56	38.35	125.47	125.44	8270.63	8256.16
7	100	1.6	1.3	137.79	137.16	524.7	532.91	45100.73	45084.4
8	100	1.8	1.3	140.9	139.63	474.33	475.89	47633.09	47501.92
9	100	2.0	1.3	124.02	124.01	423.84	423.87	43943.75	44005.34
10	100	2.2	1.3	85.97	87.38	292.66	299.73	32774.81	32586.29

Table S3b. 2-dimensional properties compared for the input projection and the best fit projection (Without D_{r2d})

Case No.	$N(I)$	$D_f(I)$	$k_f(I)$	$P(I)$	$P(O)$	$width(I)$	$width(O)$	$fitness$
1	25	1.4	1.3	1699.56	1691.22	177.92	180.64	0.00052
2	25	1.6	1.3	1002.3	995.24	146.17	145.64	0.00031
3	25	1.8	1.3	880.99	871.57	87.29	85.91	0.00666
4	25	2.0	1.3	792.65	778.52	96.33	96.52	0.00040
5	25	2.2	1.3	525.29	528.83	105.12	105.08	0.00005
6	25	2.4	1.2	497.03	494.67	88.83	88.69	0.00006
7	100	1.6	1.3	3578.14	3579.32	308.13	311.62	0.00039
8	100	1.8	1.3	3586.38	3642.92	365.23	363.84	0.00036
9	100	2.0	1.3	3048.12	3026.93	393.84	393.87	0.00005
10	100	2.2	1.3	1547.62	1546.44	231.31	230.82	0.00089

Table S4. Fractal parameters of aggregates used for input projection and the best fit aggregate obtained (**With D_{r2d}**)

Case No.	<i>Fractal parameters</i>					
	$N(I)$	$D_f(I)$	$k_f(I)$	$N(O)$	$D_f(O)$	$k_f(O)$
1	25	1.4	1.3	25	1.39	1.31
2	25	1.6	1.3	25	1.52	1.53
3	25	1.8	1.3	20	1.71	1.51
4	25	2.0	1.3	20	1.95	1.27
5	25	2.2	1.3	22	2.13	1.29
6	25	2.4	1.2	20	2.52	1.14
7	100	1.3	1.4	110	1.22	1.73
8	100	1.6	1.3	96	1.58	1.41
9	100	1.6	1.6	106	1.77	1.38
10	100	1.7	1.3	105	1.54	1.76
11	100	1.8	1.3	107	1.85	1.42
12	100	1.8	1.6	97	1.85	1.19
13	100	1.9	1.3	96	1.79	1.57
14	100	2.0	0.9	97	1.97	1.25
15	100	2.0	1.3	98	1.94	1.36
16	100	2.1	1.3	110	2.18	1.24
17	100	2.2	0.9	93	2.14	1.24
18	100	2.2	1.3	100	2.34	1.12
19	100	2.3	1.3	90	2.57	1.11
20	100	2.4	1.3	104	2.51	1.12
21	150	1.6	1.3	156	1.61	1.1
22	150	1.8	1.3	142	1.74	1.63
23	150	2.0	1.3	139	2.11	1.03
24	150	2.2	1.2	147	2.11	1.29
25	200	1.5	1.5	204	1.45	1.73
26	200	2.1	1.2	194	2.08	1.36
27	250	1.7	1.5	279	1.82	1.42
28	250	1.9	1.3	267	1.84	1.43
29	300	1.8	1.2	273	1.86	1.23
30	400	2.0	1.1	424	2.23	0.72
31	500	1.9	1.5	529	1.89	1.55

Table S5a. 3-dimensional properties of aggregates used for input projection and the best fit aggregate obtained corresponding to the same fractal parameter sets (**With D_{fd}**)

Case No.	Fractal parameters			3-dimensional properties					
	$N(I)$	$D_f(I)$	$k_f(I)$	$R_h(I)$	$R_h(O)$	$PA(I)$	$PA(O)$	$R_{pa}(I)$	$R_{pa}(O)$
1	25	1.4	1.3	87.64	85.43	14230.87	14010.98	67.32	66.80
2	25	1.6	1.3	78.65	78.43	13496.49	13394.65	65.56	65.31
3	25	1.8	1.3	70.83	64.52	12654.08	10426.14	63.48	57.62
4	25	2.0	1.3	67.72	61.40	12255.46	10018.15	62.47	56.48
5	25	2.2	1.3	62.31	60.29	11409.47	10257.18	60.28	57.15
6	25	2.4	1.2	59.73	53.33	10741.19	8743.91	58.49	52.77
7	100	1.3	1.4	215.58	237.03	54369.19	59618.12	131.59	137.79
8	100	1.6	1.3	171.04	161.79	49811.36	46832.81	125.95	122.13
9	100	1.6	1.6	158.59	154.47	47483.99	50010.54	122.97	126.20
10	100	1.7	1.3	159.23	164.72	48494.01	50696.08	124.27	127.06
11	100	1.8	1.3	148.94	141.11	47242.54	46347.33	122.66	121.49
12	100	1.8	1.6	134.84	139.24	43599.42	43153.51	117.84	117.23
13	100	1.9	1.3	138.23	138.76	44655.27	42790.49	119.25	116.74
14	100	2.0	0.9	143.53	132.09	45176.78	42086.28	119.95	115.77
15	100	2.0	1.3	127.51	129.62	41901.50	41117.26	115.52	114.43
16	100	2.1	1.3	124.55	123.45	41165.97	41591.41	114.50	115.09
17	100	2.2	0.9	129.97	119.08	42330.14	37416.95	116.11	109.16
18	100	2.2	1.3	115.99	113.34	37834.63	36879.41	109.77	108.37
19	100	2.3	1.3	109.64	97.98	35694.04	29569.86	106.62	97.04
20	100	2.4	1.3	107.79	105.88	35190.49	34242.28	105.86	104.43
21	150	1.6	1.3	213.83	231.20	71621.73	77243.85	151.03	156.84
22	150	1.8	1.3	181.85	169.66	67933.83	62449.37	147.09	141.03
23	150	2.0	1.3	160.56	145.99	61644.67	54381.19	140.11	131.60
24	150	2.2	1.2	145.04	144.34	56991.74	56282.60	134.72	133.88
25	200	1.5	1.5	254.95	262.56	96218.70	99012.69	175.05	177.57
26	200	2.1	1.2	174.38	164.56	77193.76	71559.92	156.79	150.96
27	250	1.7	1.5	241.06	232.59	108058.94	115600.28	185.51	191.87
28	250	1.9	1.3	216.02	232.40	99910.97	109279.89	178.38	186.55
29	300	1.8	1.2	270.05	235.48	132247.18	121009.46	205.22	196.31
30	400	2.0	1.1	262.01	270.85	151611.54	163339.12	219.74	228.08
31	500	1.9	1.5	290.42	300.96	185615.84	196367.79	243.13	250.08

Table S5b. 3-dimensional properties of aggregates used for input projection and the best fit aggregate obtained corresponding to the same fractal parameter sets (**With D_{f2d}**)

Case No.	Fractal parameters			3-dimensional properties					
	$N(I)$	$D_f(I)$	$k_f(I)$	$d_m(I)$	$d_m(O)$	$A_{13}(I)$	$A_{13}(O)$	$R_{g3d}(I)$	$R_{g3d}(O)$
1	25	1.4	1.3	141.76	140.17	4.5095	5.0842	123.31	124.52
2	25	1.6	1.3	135.89	135.38	4.2407	3.3849	94.42	93.62
3	25	1.8	1.3	129.70	117.55	5.6151	3.1540	76.64	67.10
4	25	2.0	1.3	126.91	114.61	2.5511	3.2624	64.79	60.57
5	25	2.2	1.3	121.30	115.39	2.6512	3.4326	56.42	55.69
6	25	2.4	1.2	117.41	105.71	2.5778	2.3258	51.93	45.32
7	100	1.3	1.4	312.83	334.91	14.3500	6.5466	399.92	450.93
8	100	1.6	1.3	280.86	269.42	3.6574	6.2747	226.09	216.59
9	100	1.6	1.6	269.07	271.80	5.2615	3.0999	198.53	173.93
10	100	1.7	1.3	271.56	279.22	4.4009	5.3774	192.64	213.09
11	100	1.8	1.3	262.99	256.42	3.7274	3.4225	167.05	154.73
12	100	1.8	1.6	247.11	248.88	6.1758	4.5869	148.78	161.44
13	100	1.9	1.3	251.31	247.84	2.8064	2.6284	147.03	148.89
14	100	2.0	0.9	255.59	242.38	4.6608	3.1204	157.64	136.09
15	100	2.0	1.3	239.13	238.88	3.9585	2.7407	131.06	135.56
16	100	2.1	1.3	235.79	235.90	2.0549	2.4770	118.08	116.83
17	100	2.2	0.9	241.54	224.74	2.5156	2.3159	127.08	112.20
18	100	2.2	1.3	246.30	220.01	2.4789	2.1474	107.39	101.60
19	100	2.3	1.3	215.20	194.63	2.1524	1.6832	98.44	82.15
20	100	2.4	1.3	212.97	209.77	1.8353	1.6996	94.01	90.48
21	150	1.6	1.3	348.14	368.70	4.6729	7.1362	291.46	325.28
22	150	1.8	1.3	321.12	303.83	4.9729	4.9335	209.44	195.16
23	150	2.0	1.3	296.11	274.01	2.6788	5.0555	160.71	152.87
24	150	2.2	1.2	277.47	275.85	2.0067	2.5994	134.16	141.06
25	200	1.5	1.5	415.10	424.49	7.4703	6.8580	391.31	402.35
26	200	2.1	1.2	328.68	313.39	2.3363	2.4224	171.05	161.39
27	250	1.7	1.5	420.94	422.36	5.6204	4.7885	303.91	272.75
28	250	1.9	1.3	390.77	415.28	4.5985	2.6976	238.61	258.43
29	300	1.8	1.2	472.42	430.49	3.6363	2.7520	322.10	273.61
30	400	2.0	1.1	483.33	501.54	3.7747	3.1518	285.80	262.96
31	500	1.9	1.5	538.09	556.60	3.7488	3.5792	318.89	328.17

Table S6a. 2-dimensional properties compared for the input projection and the best fit projection (With D_{r2d})

Case No.	$N(I)$	$D_f(I)$	$k_f(I)$	$R_{g2D}(I)$	$R_{g2D}(O)$	$L_{max}(I)$	$L_{max}(O)$	$A_{proj}(I)$	$A_{proj}(O)$
1	25	1.4	1.3	112.6	114.25	397.31	396.81	15782.76	15903.79
2	25	1.6	1.3	83.76	84.59	282.79	283.49	11818.82	11632.93
3	25	1.8	1.3	64.85	63.74	180.29	176.15	10845.73	10623.27
4	25	2.0	1.3	50.19	49.387	170.287	170.23	9798.83	9877.53
5	25	2.2	1.3	40.28	39.91	135.12	132.44	9008.66	9170.95
6	25	2.4	1.2	38.56	38.65	125.47	126.25	8270.63	8346.07
7	100	1.3	1.4	230.24	236.33	866.09	854.99	46995.38	47632.32
8	100	1.6	1.3	137.79	135.31	524.7	519.83	45100.73	45082.12
9	100	1.6	1.6	162.97	162.9	535.75	544.22	50098.3	49667.59
10	100	1.7	1.3	140.47	138.27	473.12	466.48	45678.32	45499.84
11	100	1.8	1.3	140.9	138.87	474.33	468.99	47633.09	47780.08
12	100	1.8	1.6	139.07	141.66	490.53	488.31	43520.25	44074.14
13	100	1.9	1.3	131.41	131.29	441.14	442.47	42890.55	43449.85
14	100	2.0	0.9	135.16	134.89	492.39	491.11	49122.48	48822.69
15	100	2.0	1.3	124.02	124.38	423.84	420.76	43943.75	43690.64
16	100	2.1	1.3	94.54	94.74	339.34	333.71	39110.60	39664.75
17	100	2.2	0.9	92.49	93.20	473.12	474.28	38150.24	38641.81
18	100	2.2	1.3	85.97	85.09	292.66	286.24	32774.81	33047.31
19	100	2.3	1.3	75.45	74.93	235.52	234.72	30266.78	30286.19
20	100	2.4	1.3	83.98	84.05	281.90	279.63	32981.28	33046.69
21	150	1.6	1.3	233.88	229.09	947.09	918.91	73166.5	73952.27
22	150	1.8	1.3	180.75	184.92	666.43	675.46	69932.93	69284.36
23	150	2.0	1.3	148.11	147.56	552.57	546.18	60025.47	59864.22
24	150	2.2	1.2	123.02	123.56	415.34	418.36	58733.39	58263.73
25	200	1.5	1.5	341.07	342.15	1133.94	1109.26	99511.15	100018.55
26	200	2.1	1.2	151.92	150.82	559.65	550.12	79541.57	80151.52
27	250	1.7	1.5	237.66	236.15	879.92	882.33	109196.65	108532.26
28	250	1.9	1.3	222.36	220.51	768.30	775.09	101467.94	101352.15
29	300	1.8	1.2	199.31	194.26	760.48	768.44	113578.68	112965.54
30	400	2.0	1.1	241.97	239.05	912.66	911.87	147163.67	145756.26
31	500	1.9	1.5	319.87	314.14	977.06	951.74	208131.02	206954.51

Table S6b. 2-dimensional properties compared for the input projection and the best fit projection (With D_{f2d})

Case No.	$N(I)$	$D_f(I)$	$k_f(I)$	$P(I)$	$P(O)$	$width(I)$	$width(O)$	$D_{f2d}(I)$	$D_{f2d}(O)$	$fitness$
1	25	1.4	1.3	1699.56	1683.07	177.92	179.61	1.1761	1.2084	0.00121
2	25	1.6	1.3	1002.3	1018.35	146.17	146.53	1.3291	1.3289	0.00061
3	25	1.8	1.3	880.99	855.17	87.29	86.34	1.4169	1.4053	0.00229
4	25	2.0	1.3	792.65	797.37	96.33	96.42	1.5804	1.6062	0.00062
5	25	2.2	1.3	525.29	527.77	105.12	105.69	1.8403	1.8253	0.00092
6	25	2.4	1.2	497.03	495.85	88.83	88.42	1.8273	1.8215	0.00016
7	100	1.3	1.4	4006.86	4032.77	525.59	523.86	1.2537	1.2435	0.00117
8	100	1.6	1.3	3578.14	3644.07	308.13	304.29	1.2415	1.3195	0.00485
9	100	1.6	1.6	3917.34	3922.03	312.28	314.15	1.3535	1.3427	0.00043
10	100	1.7	1.3	3447.4	3466.25	378.82	372.88	1.4285	1.4388	0.00079
11	100	1.8	1.3	3586.38	3543.96	365.23	364.22	1.4836	1.4578	0.00079
12	100	1.8	1.6	3107.02	3149.42	382.76	383.37	1.3665	1.3695	0.00072
13	100	1.9	1.3	3251.89	3228.34	390.57	385.51	1.5349	1.5397	0.00041
14	100	2.0	0.9	3914.99	3906.75	401.49	403.87	1.5001	1.4696	0.00050
15	100	2.0	1.3	3048.12	3049.29	393.84	390.76	1.6214	1.5966	0.00039
16	100	2.1	1.3	2397.98	2409.75	275.17	275.80	1.6351	1.6361	0.00051
17	100	2.2	0.9	2520.48	2554.19	240.49	241.06	1.6573	1.6616	0.00042
18	100	2.2	1.3	1547.62	1592.38	231.31	231.98	1.6799	1.6549	0.00172
19	100	2.3	1.3	1461.64	1466.39	205.52	204.72	1.7945	1.7838	0.00012
20	100	2.4	1.3	1485.20	1498.16	245.94	249.63	1.7828	1.7704	0.00042
21	150	1.6	1.3	5707.56	5766.45	759.33	747.24	1.2722	1.265	0.00181
22	150	1.8	1.3	5507.33	5439.06	408.86	412.88	1.4892	1.4931	0.00105
23	150	2.0	1.3	4070.46	4052.17	299.69	297.56	1.5383	1.5296	0.00026
24	150	2.2	1.2	3613.47	3611.12	385.349	388.36	1.6781	1.6733	0.00021
25	200	1.5	1.5	8261.00	8316.77	629.21	620.31	1.1216	1.1325	0.00085
26	200	2.1	1.2	5138.72	5181.25	457.27	456.23	1.5837	1.5962	0.00054
27	250	1.7	1.5	6766.43	6712.39	600.63	624.01	1.3495	1.3628	0.00176
28	250	1.9	1.3	6427.22	6401.21	499.58	502.06	1.421	1.4225	0.00019
29	300	1.8	1.2	7581.45	7658.25	564.61	555.26	1.4617	1.4651	0.00116
30	400	2.0	1.1	8699.20	8684.16	557.25	549.16	1.4219	1.4269	0.00046
31	500	1.9	1.5	9189.15	9221.15	564.61	547.48	1.4448	1.4288	0.00208

Table S7. Comparison of fractal parameters prediction between Thajudeen et al. and the proposed method

Case no.	Input			Thajudeen et al., 2015			Proposed method		
	N	D_f	k_f	N	D_f	k_f	N	D_f	k_f
1	25	1.4	1.3	30	1.3	2	25	1.39	1.31
2	25	1.6	1.3	20	1.3	1.7	25	1.52	1.53
3	25	1.8	1.3	30	1.8	1.7	20	1.71	1.51
4	25	2	1.3	20	1.9	1.2	20	1.95	1.27
5	25	2.2	1.3	20	2.4	1.7	22	2.13	1.29
6	25	2.4	1.2	20	2.9	1.3	20	2.52	1.14
7	100	1.3	1.4	100	1.3	1.3	110	1.22	1.73
8	100	1.6	1.3	100	1.7	2	96	1.58	1.41
9	100	1.6	1.6	100	1.6	1.7	106	1.77	1.38
10	100	1.7	1.3	100	1.7	1.5	105	1.54	1.76
11	100	1.8	1.3	100	1.7	2	107	1.85	1.42
12	100	1.8	1.6	100	1.6	2	97	1.85	1.19
13	100	1.9	1.3	100	1.7	2	96	1.79	1.57
14	100	2	0.9	100	1.9	1.3	97	1.97	1.25
15	100	2	1.3	100	1.8	1.5	98	1.94	1.36
16	100	2.1	1.3	100	2.3	1.3	110	2.18	1.24
17	100	2.2	0.9	100	2	1.3	93	2.14	1.24
18	100	2.2	1.3	100	2.4	1.3	100	2.34	1.12
19	100	2.3	1.3	100	2.1	2	90	2.57	1.11
20	100	2.4	1.3	100	2.4	1.3	104	2.51	1.12
21	150	1.6	1.3	200	1.4	2	156	1.61	1.1
22	150	1.8	1.3	200	1.8	2	142	1.74	1.63
23	150	2	1.3	200	1.9	1.5	139	2.11	1.03
24	150	2.2	1.2	200	2	1.5	147	2.11	1.29
25	200	1.5	1.5	200	1.5	1.3	204	1.45	1.73
26	200	2.1	1.2	200	1.9	2	194	2.08	1.36
27	250	1.7	1.5	300	1.7	2	279	1.82	1.42
28	250	1.9	1.3	300	1.8	1.7	267	1.84	1.43
29	300	1.8	1.2	400	1.5	2	273	1.86	1.23
30	400	2	1.1	400	1.8	1.7	424	2.23	0.72
31	500	1.9	1.5	800	1.9	2	529	1.89	1.55