Fractal Parameter Examples

Mandelbrot outward zooms:

-2.75	1.75	+/- 2.25
-3.0	2.0	+/- 2.5
-3.25	2.25	+/- 2.75
-4.75	3.75	+/- 4.25
-5.5	4.5	+/- 5.0

Mandelbrot sets:

-1.793	-1.739	+/- 0.027		ray-like filaments	
-0.85	-0.7	0.0	0.15	Seahorse Valley	
-0.75084	-0.73991	0.10468	0.11561	BOF Map 36	
				maxiter: 1024	
				palette: Linda-009	
				TIA mask:	DJ
					maxiter: 76
					maxsize/bailout: 1e+8

Julia sets:

1	-0.11	0.656	BOF Map 24 - period 3
2	-0.194	0.656	BOF Fig. 13 - transition: #1 to Cantor set
3	0.2601	0.00175	Cantor set
4	0.32	0.043	BOF Map 18 - period 11 dragon
5	-0.742	0.126	Seahorse Valley - period 25
6	-0.74543	0.11301	BOF Fig. 15, SFI 4.15 - transition #5 to Cantor set
7	-0.7475	0.0825	complete transition #5 to Cantor set
8	-1.25	0.0	BOF Fig. 9 - period 4 parabolic
9	0.27334	0.00742	BOF Fig. 8 - period 20 parabolic
10	-0.4818	-0.5317	BOF Fig. 6 - period 5 parabolic
11	-0.39054	-0.58679	BOF Maps 22, 25, Fig.7 - Siegel disk
12	-0.122	0.745	BOF Fig. 4 - Douady rabbit - period 3
13	0.11031	-0.67037	BOF Fig. 11 - Fatou dust
14	-0.15652	1.03225	BOF Fig. 14 - dendrite with beads
14a	-0.15436	1.03713	alternate dendrite with beads
14b	-0.15428	1.03096	alternate dendrite with beads
15	-0.3869	0.59349	period 21
16	-0.2405	0.646	Cantor set
17	0.292	-0.483	Cantor set - spirals
18	0.360284	0.100376	period 8 dragon
19	-0.9	0.12	period 2
20	0.3	0.5	period 4 dragon
21	-0.09571678	0.65403036	Chaos in Wonderland, Plate 2

22	0.4052405	0.1467907	more from Chaos in Wonderland
23	-0.74858089	0.06360646	" "
24	0.37953073	0.2056703	" "

Julia set parabolic c values - from Adam Majewski

Internal angle (rotation number) t = 1/n	root point c	2 external angles of parameter rays landing on the root point c	fixed point	external angles of dynamic rays landing on fixed point
1/1	0.25	(0/1 = 1/1)	0.5	(0/1 = 1/1)
1/2	-0.75	(1/3; 2/3)	-0.5	(1/3; 2/3)
1/3	-0.125 + 0.64951905283833i	(1/7; 2/7)	-0.25 + 0.43301270189222i	(1/7; 2/7; 3/7)
1/4	0.25 + 0.5i	(1/15; 2/15)	0.5i	(1/15; 2/15; 4/15; 8/15)
1/5	0.35676274578121 + 0.32858194507446i	(1/31; 2/31)	0.15450849718747 + 0.47552825814758i	(1/31; 2/31; 4/31; 8/31; 16/31)
1/6	0.375 + 0.21650635094611i	(1/63; 2/63)	0.25 + 0.43301270189222i	(1/63; 2/63; 4/63; 8/63; 16/63; 32/63)
1/7	0.36737513441845 + 0.14718376318856i	(1/127; 2/127)	0.31174490092937 + 0.39091574123401i	(1/127; 2/127, 4/127; 8/127; 16/127; 32/127, 64/127)
1/8	0.35355339059327 + 0.10355339059327i		0.35355339059327 + 0.35355339059327i	
1/9	0.33961017714276 + 0.075191866590218i		0.38302222155949 + 0.32139380484327i	
1/10	0.32725424859374 + 0.056128497072448i		0.40450849718747 + 0.29389262614624i	

Julia set: α = 1/5

parabolic	0.35676	0.32858
attractive	0.3609	0.3326
superattractive	0.3793135	0.3358395
Siegel disk	0.349829	0.348154

Magnetism Models - from *The Beauty of Fractals*

Model I - parameter plane

Re q		Im q		
-1.25	3.75	-2.5	2.5	Map 1; Fig. 54c (program default)
1.85	2.15	1.5	1.8	Map 2; Fig. 54b
1.2882	1.2962	0. 9695	0.9755	Maps 11, 12
1.2906	1.2911	0.9727	0.9732	Map 13

Model II - parameter plane

Re q		Im q		
-0.75	2.75	-1.75	1.75	Map 16; Fig. 54f (program default)
1.9	2.0	0.865	0.965	Maps 14, 15; Fig. 54e

Model I - dynamic plane

q	Re x		Im x		
2.0	-6.0	6.0	-6.0	6.0	Fig. 54g (program default)
-1.0	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54a
-0.1	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54b
0.0	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54c
1.0	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54d
1.2	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54e
1.6	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54f
2.5	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54h
2.9	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54i
3.0	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54j
3.1	≈ -6.0	≈ 6.0	-6.0	6.0	Fig. 54k
4.0	-5.0	7.0	-6.0	6.0	Fig. 54l; Map 3
-0.1	0.65	1.75	2.5	3.6	Map 4
1.09582 + 2.07142i	0.6	1.5	-1.5	-0.6	Map 5
1.21 + 0.01i	-2.1	-0.3	-0.9	0.9	Map 6

Model II - dynamic plane

q	Re x		Im x		
2.0	-12.0	12.0	-12.0	12.0	Map 7 (program default)
1.22 + 2.0i	-3.2	3.8	-3.55	3.45	Maps 8, 9, 10

Perturbated gingerbread men

(Original TURBO BASIC program by Fausto A. A. Barbuto and Victor Ielo)
The gingerbread men concept involves selecting initial values of x and y, and iterating according to the algorithm:

1) $x = 1.0 - y + |x|$
2) $y = x$

Then, x and y are converted to integers and adjusted by a scale factor. Pixel (x, y) is plotted if it is located within the screen coordinates and is colored according to the number of iterations (or in this instance according to the 4th root of the number of iterations). The perturbated routine adds a value f to 1) in the above algorithm. One example of f is:

3) 1.0E-4 * cos(|y|) * sin(|x|)

The number of iterations is limited to 10 million; even with a small scale factor the screen will usually be filled with 2 million or less. Often a pattern will not develop until it has looked quite stagnant for a few hundred-thousand iterations

Fausto and Victor suggest the following initial Xi, Yi pairs: (Cases f and g seem to produce the most interesting variations....)

Case a: 1.0E-4 * cos(y * |x|)

Xi = 1.333 , Yi = 2.777   Xi = 1.111 , Yi = 0.500

Case b: 1.0E-4 * cos(|y|) * sin(|x|)

Xi = 1.333 , Yi = 2.777   Xi = 3.1717 , Yi = 4.1777

Case c: -2.0E-6 * tan(y)

Xi = -0.707 , Yi = 2.777   Xi = -0.707 , Yi = -2.777
Xi = -0.70707 , Yi = -2.77777   Xi = -0.707 , Yi = 2.555
Xi = 0.0 , Yi = 0.0   Xi = -0.111 , Yi = 2.333

Case d: 1.0E-5 * sin(|x|) / cos(|y|)

Xi = 1.0, Yi = 2.0   Xi = 2.534 , Yi = 0.0
Xi = 3.1415, Yi = 0.0   Xi = -1.335 , Yi = 0.545
Xi = -1.335, Yi = 2.133

Case e: 5.0E-6 * cos(|y|) / sin(|y|)

Xi = 0.1111 , Yi = 0.5   Xi = 0.3333 , Yi = 0.1
Xi = 0.070707 , Yi = 0.555555   Xi = 0.71717 , Yi = 0.13131
Xi = 0.1111 , Yi = -3.7777   Xi = 0.1111 , Yi = 0.2
Xi = 0.30303 , Yi = -0.77777

Case f: 5.0E-5 * cos(|y|) / sin(|x|)

Xi = 0.323 , Yi = 0.535	Xi = 0.323 , Yi = 0.555
Xi = 0.323 , Yi = 0.0	Xi = 0.001 , Yi = 0.001
Xi = -1.3333 , Yi = 0.0	Xi = -1.3333 , Yi = 0.5
Xi = -1.3333 , Yi = -0.3	Xi = -1.3333 , Yi = -0.5
Xi = -0.007 , Yi = 1.567	Xi = 3.555 , Yi = 0.100
Xi = 2.003 , Yi = -0.910	Xi = -0.5 , Yi = -1.3333

Case g: 1.0E-5 * cos(|y|) / cos(|x|)

Xi = 0.858 , Yi = 0.952	Xi = 0.323 , Yi = 0.555
Xi = 0.323 , Yi = 0.0	Xi = 2.777 , Yi = 0.0
Xi = 2.7777 , Yi = 0.0	Xi = 0.707 , Yi = 0.333
Xi = 2.3333 , Yi = -0.5	Xi = 2.3333 , Yi = -0.25
Xi = 0.02 , Yi = 2.3333	Xi = -0.075 , Yi = -2.3333
Xi = 0.757 , Yi = 0.888	

"A small change in any component of these (Xi, Yi) pairs is enough to generate a completely different GM - even if the change is at the fifth (or higher) decimal place.

"Patience is highly recommended when running some of the cases above! Some particular cases seem to be - at a first look - the same as the usual GM (without perturbation), but they may take a few million iterations to show their real faces. Some other PGM will show their unusual patterns very early.

"The behaviour of the PGM is really unforeseeable. Some functions may show overflow depending upon the selected parameters (the cases above won't); some others may "converge" to a point the plotting stops and the PGM will not change anymore (this is the case when spirals are formed inside the hexagons - wherever they are located, inside or outside PGM's body - and displace towards the center of these hexagons, where the spiral's arms will touch)."

Fausto & Victor - Rio de Janeiro, Brazil, November 18th, 1993.

Different operating systems handle floating point calculations differently, so the same parameter set could yield completely different images on different systems. - M.S.

Volterra-Lotka predator-prey equations

Date: Mon, 17 Feb 1997 10:04:22 +0100 (MET)
From: Simone Avogadro <simonea@ing.unico.it>
To: Michael Sargent <msargent@zoo.uvm.edu>
Subject: Re: Volterra-Lotka parameters

p: 0.739	h: 0.739			
Window:	xmin= -1	xmax= 9	ymin= -1	ymax= 7
p: 0.83	h: -0.3			
Window:	xmin= -5.5	xmax= 4.5	ymin= -4.125	ymax= 3.875
p: 0.5	h: 0.8			
Window:	xmin= 0.528809	xmax= 1.271	ymin= 1.27197	ymax= 1.86572

p: 0.05	h: 0.239			
Window:	xmin= -2	xmax= 10.5	ymin= -1	ymax= 9
p: 0.05	h: 0.26			
Window:	xmin= -9	xmax= 29.75	ymin= -1	ymax= 30
p: 0.05	h: 0.23			
Window:	xmin= -7.95557	xmax= 14.9009	ymin= -0.697266	ymax= 17.5879
p: 0.05	h: 0.23			
Window:	xmin= -7.95557	xmax= 14.9009	ymin= -0.697266	ymax= 17.5879
p: 0.05	h: 0.239			
Window:	xmin= -9	xmax= 29.75	ymin= -1	ymax= 30
p: 0.05	h: 0.239			
Window:	xmin= -2.68799	xmax= 5.03174	ymin= 9.83789	ymax= 16.0137
p: 0.06487	h: -0.318965			
Window	xmin= 4.63275	xmax= 7.13275	ymin= 0.262078	ymax= 2.26208
p: 0.5	h: 0.8			
Window:	xmin= 0.037109	xmax= 3.00586	ymin= -0.054687	ymax= 2.32031
p: 0.5	h: 0.8			
Window:	xmin= 0.584473	xmax= 1.32666	ymin= 0.919434	ymax= 1.51318
p: 0.973022	h: 1.34033			
Window:	xmin= 0.143555	xmax= 1.87207	ymin= 0.347656	ymax= 1.73047
p: 0.973022	h: 1.0			
Window:	xmin= 0.143555	xmax= 1.87207	ymin= 0.347656	ymax= 1.73047
p: 0.73	h: -0.73			
Window:	xmin= -1.07031	xmax= 4.27344	ymin= -2.52344	ymax= 2.82031
p: 0.2	h: 0.639			
Window:	xmin= -1	xmax= 9	ymin= -1	ymax= 7
p: 0.5	h: 0.8			
Window:	xmin= 0	xmax= 11.875	ymin= -0.5	ymax= 9
p: 0.3	h: 0.8			
Window:	xmin= 0	xmax= 11.875	ymin= -0.5	ymax= 9
p: 0.08965	h: -0.398965			
Window:	xmin= -0.999996	xmax= 8.99997	ymin= -0.99997	ymax= 7
p: 0.1965	h: -0.428965			
Window:	xmin= -0.999996	xmax= 8.99997	ymin= -0.99997	ymax= 7
p: 0.1965	h: -0.128965			
Window:	xmin= -0.999996	xmax= 8.99997	ymin= -0.99997	ymax= 7
p: 0.05987	h: -0.278965			
Window:	xmin= -0.999999	xmax= 8.99999	ymin= -0.999989	ymax= 7
p: 0	h: 0.739			
Window:	xmin= -1	xmax= 9	ymin= -1	ymax= 7
p: 0.05987	h: -0.278965			
Window:	xmin= -0.042592	xmax= 2.4574	ymin= 0.133343	ymax= 2.13334
p: 0.71	h: 0.739			
Window:	xmin= -1	xmax= 9	ymin= -1	ymax= 7
p: 0.3	h: 0.5			
Window:	xmin= 0	xmax= 11.875	ymin= -0.5	ymax= 9

Lyapunov exponents - classic maps (cf. Markus article)

For AB and BA, use $x_0 = 0.85$; for the rest, use $x_0 = 0.5$.

AABAB	$2.0 < x, y < 4.0$				
BBABA	" "				
BBBAAA	$0.6 < x < 4.0$		$0.8 < y < 4.2$		
BBABABA	$2.75 < x < 3.75$		$3.25 < y < 4.25$		
BBBBBAAAAA					
BBBBBBAAAAAA		"Zircon City"	$2.5 < x < 3.4$	$3.4 < y < 4.0$	(3:2)
AAAAAAAAAAAAB					

Complex rational maps - Devaney

$z_1 = z_0^N + \lambda / z_0^D$

Critical points satisfy: $z^{(N + D)} = \lambda * D / N$, thus: $z_0 = (\lambda * D / N)^{(1.0 / (N + D))}$

If N==D, parameter plane critical point can be simplified to: $z_0 = 2.0 * \sqrt{\lambda}$

Parameter Plane

N	D	window			
2	3	-0.1235	-0.1135	Bud-007	
		-0.004	0.004		
2	3	-0.12930306	-0.12216486	Bud-007	
		-0.04357853	-0.03644033		
2	3	-0.000146	0.000146	Linda-001	
		-0.000146	0.000146		
4	4	0.15443108	0.15587254	Rainbow	"QS Little Sister"
		0.03284912	0.03429058		
4	1	-0.75	0.75	Greens	
		-0.75	0.75		
5	1	-0.75	0.75	Bud-007	
		-0.75	0.75		
5	4	-0.3	0.3	QS-EZF	
		-0.3	0.3		

Dynamic Plane

2	2	-1.2	1.2	-0.15	QS-BOF
		-1.2	1.2		
2	2	-1.225	1.225	0.08	Reds
		-1.225	1.225		

2	4	-1.225	1.225	0.08	001
		-1.225	1.225		
2	4	0.09099814	0.29544156	0.08	001
		0.50288497	0.70732839		
3	3	-1.2	1.2	-0.2 + 0.11 i	127
		-1.2	1.2		
3	3	-1.225	1.225	0.0625	Chroma
		-1.225	1.225		
3	3	-0.52299834	0.53697323	0.015 + 0.05	QS-BG-Step4
		-1.225	1.225		
4	3	-1.2	1.2	0.04	Damien-003
		-1.2	1.2		
4	3	-1.2	1.2	0.18	QS-000000
		-1.2	1.2		
4	4	-1.2	1.2	0.0 + 0.125 i	Linda-010
		-1.2	1.2		

Burning ship - dynamic plane c values

Many of these parameters are suggested by Jeremy Avnet at
https://theory.org/fracdyn/burningship/
I've reversed the sign of the imaginary component of the formula so that the ship is drawn upright on a coordinate system in which the values on the y-axis increase from bottom to top. To compensate, the signs of Avnet's imaginary components also had to be reversed.

$z = (|x| - |y| i)^2 + c$

-1.764 + 0.06i	0.0 + 1.6i
-1.15 + 0.4i	0.29 + 0.29i
-1.11 - 0.022i	0.425 + 0.25i
-1.0 + 1.0i	0.675 + 1.15i
-0.8 - 0.1i	0.87 + 1.52i
-0.75 + 0.9i	0.975 + 1.175i
0.0 - 0.297i	

Collatz conjecture zooming

Sample parameter plane parameters; z0 = (0 + 0i) (as opposed to critical point (-1.27107 + 0i))
$-0.79855 < x < -0.79805$ $\quad$ $-0.00025 < y < 0.00025$

Sample dynamic plane parameters; c = 0 + 0i:
$-1.02520 < x < -0.95758$ $\quad$ $-0.03381 < y < 0.03381$
$-0.99146446 < x < -0.99133875$ $\quad$ $0.03153972 < y < 0.03166457$