Hyperacuity, pattern recognition and binding problem: what fractals may tell us

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Mandelbrot and Julia sets are generated by iterated projections (function: f(z)=z*z + c) of the complex plane to itself[Mandelbrot, 1983, The fractal geometry of nature, New York, Macmillan]. In geometrical interpretation, we reach z*z by following the logarithmic spiral through z to the doubling of the angle to the x-axis. Combining spiralic and straightlined movement of addition of vector c, we get spiralic trajectories with strictly topographic projections(fig. 1e,f). Assuming neurons, representing complex numbers, send their axons along those trajectories to subsequent neurons, we get neural nets with a very rich connectivity[Kromer, 2001, lecture notes in computer science 2206,917-923]. Regions of the whole net will be connected more or less strongly with any part of the net(fig. 1a,c) and vice versa by recurrent connections(fig. 1b,c). Each neuron will represent a pattern of the whole net(fig. 1d), eventually important for binding problem and pattern recognition. Neighboured neurons will represent similar but not identical patterns. Divergent axones will separate activities, overlapping at the input layer, after few iterative projections(fig 1e-f) contributing to hyperacuity. Within the Mandelbrot set, we find a central structure, resembling to a thalamus(fig. 1g), with ipsi- and contralateral connections and similar structures in threedimensional equivalents of Mandelbrot(fig. 1h,i) or Julia sets(fig. 1c,j). Studying fractal neural nets may improve our understanding of structure and function of the human brain.

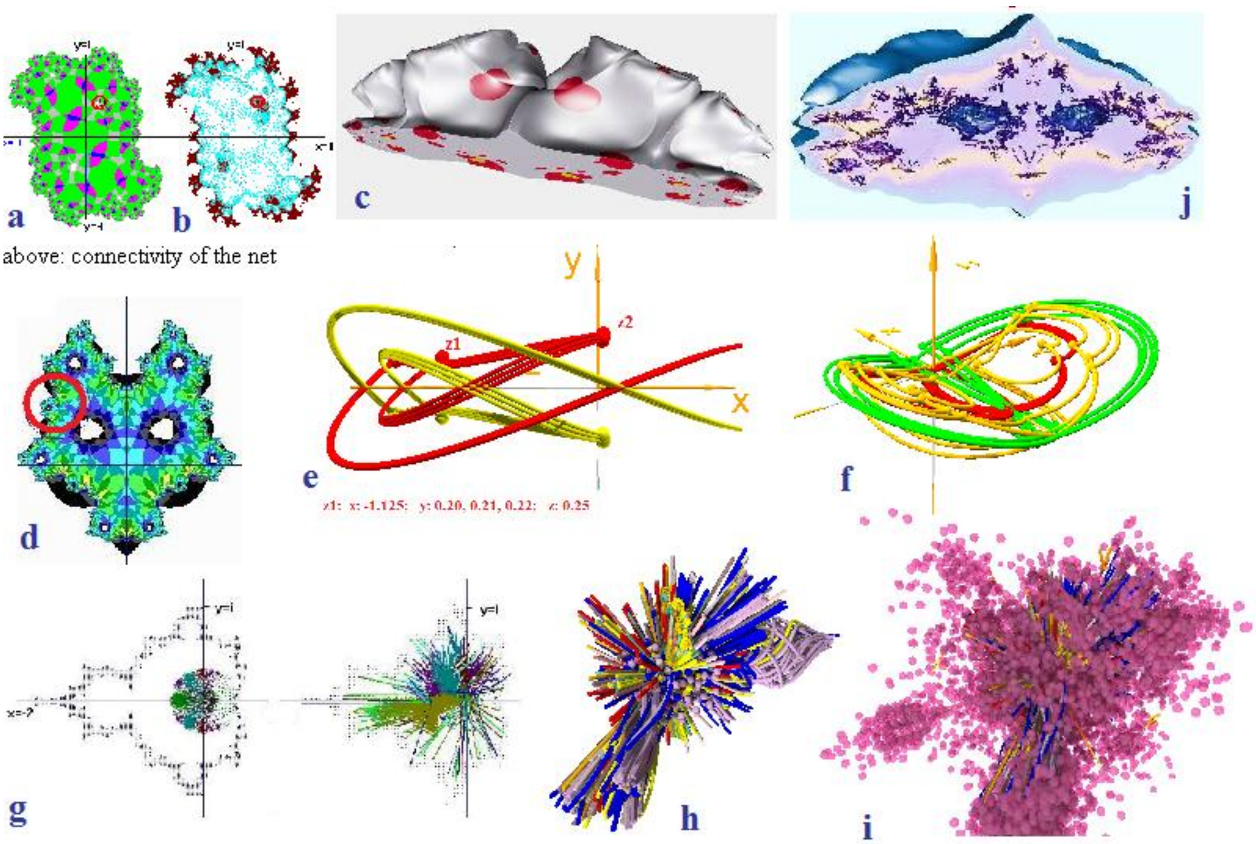

Figure 1