Virtual Education Lab: The evolution of the Diffusing Fractal (Diffractal)

Acoustical treatment has an operational bandwidth. Porous velocity absorbers typically absorb in the mid-high frequencies and resonant pressure absorbers typically are effective at low frequencies. This is also true for diffusing surfaces. The traditional reflection phase grating (RPG) is a mid-frequency diffusor. To extend the bandwidth of the RPG, we utilized a fractal design, much like a coaxial loudspeaker, in which the Diffusing Fractal (Diffractal) contains a nested, scaled replica diffusor to extend the high frequency effectiveness. This is called a self-similar surface. The idea of a fractal is best illustrated with the Koch fractal. In Figure 1, we show the 4 segments forming the base shape, n=1 at the top. The n=1 base shape is reduced in scale and nested into each of the original four segments, forming the second generation surface, n=2. The second generation surface is then scaled and nested into each of the 16 segments of the n=2 shape, forming n=3 (not shown). This process continues for as many generations as desired. The n=4 surface is shown. A geometrical surface like a circle, has a finite circumference, as it is approximated with an infinite number of smaller and smaller facets. A fractal, on the other hand, has an infinite surface, as you approach an infinite number of generations.

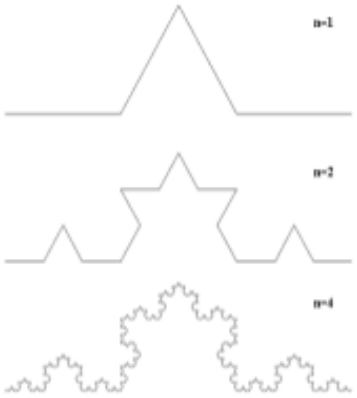

Figure 1. Koch fractal.

Therefore, the fractal is a perfect way to design a broad bandwidth diffusor, using nested, scaled replicas to address different frequency ranges with embedded low, mid, and high frequency elements. This is similar to a full frequency loudspeaker with a woofer, mid-range, and tweeter. The QRD based Diffractal is shown in Figure 2. The high frequencies are diffused by a device called FlutterFree, which forms the well bottoms of a standard mid-range QRD. To achieve low frequency diffusion, the second generation Diffractal units are translated into the room following the QRD sequence. Manfred Schroeder was fascinated with the Diffractal and included it in his book "Fractals, Chaos, and Power Laws," Schroeder, M.R, Freeman (1991) and in a memorial volume in his honor "Acoustics, Information, and Communication", Xiang, N. and Sessler, G.M. Editors, Springer (2015).

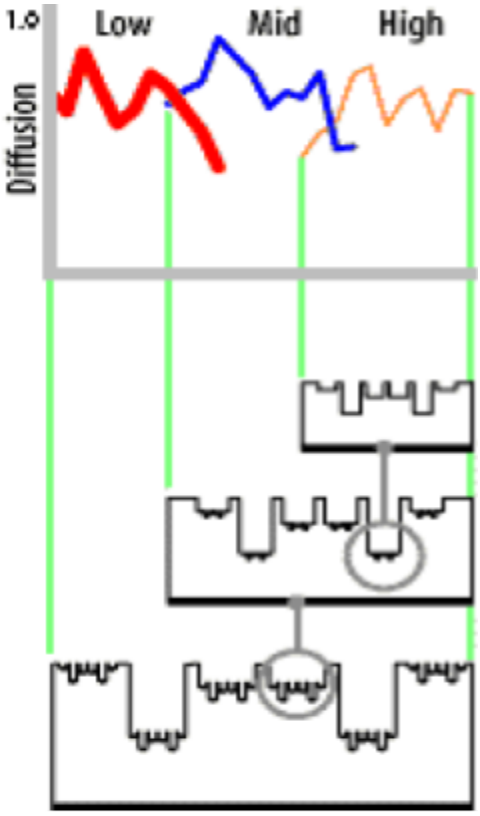

Figure 2. The third generation Diffractal.

Examples, are shown in Figure 3, at one of the original Diffractal installations in 1989 at Real World Studios, in Box, Wiltshire, England and at Rue Boyer, a recent control room for Mix with the Masters in Paris, Figure 4.

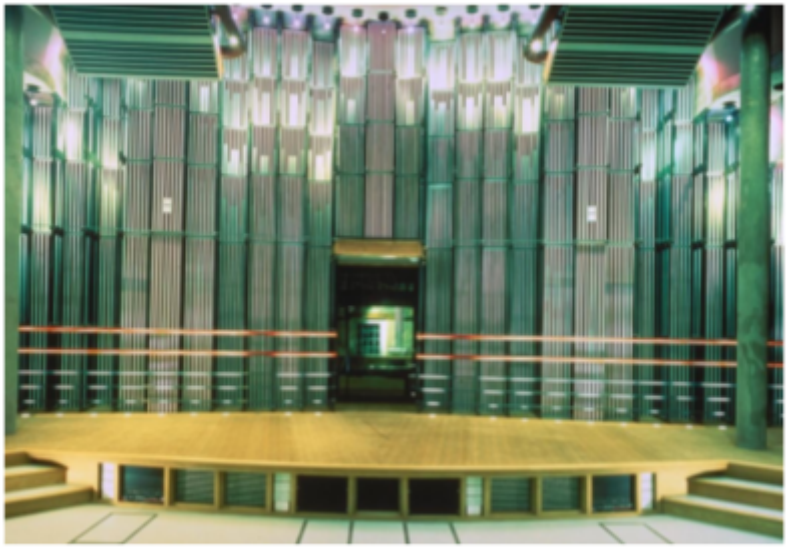

Figure 3.Real World Studios, Box, Wiltshire, England.

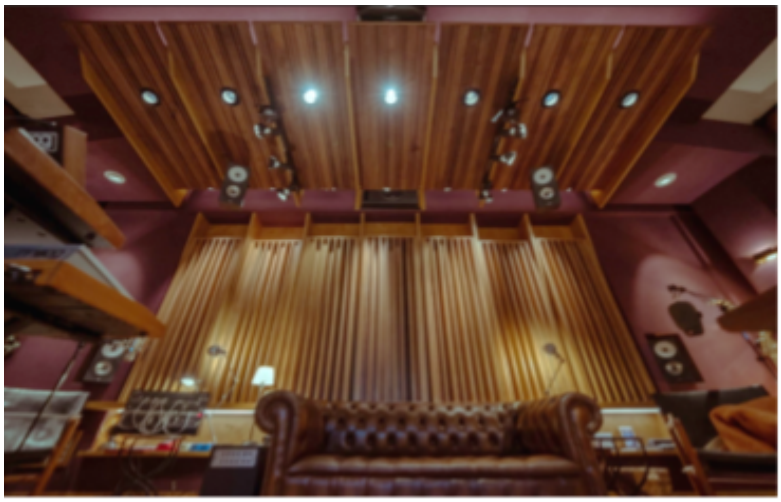

Figure 4.Rue Boyer @ Mix with the Masters, Paris, France.

Teaser: How is the diffusion bandwidth expanded with a diffusing fractal (Diffractal)?

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