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An Introduction to Complex Fractal Dimensions

We will give some sample results from the new higher-dimensional theory of complex fractal dimensions developed jointly with Goran Radunovic and Darko Zubrinic in the 700-page research monograph (joint with these same co-authors), "Fractal Zeta Functions and Fractal Drums: Higher Dimensional Theory of Complex Dimensions" [2], published by Springer in 2017 in the Springer Monographs in Mathematics series. We will also explain its connections with the earlier one-dimensional theory of complex dimensions developed, in particular, in the research monograph (by the speaker and Machiel van Frankenhuijsen) entitled "Fractal Geometry, Complex Dimensions and Zeta Functions: Geometry and Spectra of Fractal Strings" [1] (Springer Monographs in Mathematics, Springer, New York, 2013; 2nd rev. and enl. edn.).

If time permits, we will discuss and extend to any dimension the general definition of fractality proposed by the author (and M-vF) in [1], as the presence of nonreal complex dimensions. Finally, we may also discuss fractal tube formulas which enable us to express the intrinsic oscillations of fractal objects in terms of the underlying complex dimensions and the residues of the associated fractal zeta functions. Intuitively, the real parts of the complex dimensions correspond to the amplitudes of the associated "geometric waves", while their imaginary parts correspond to the frequencies of those waves.