# Beauty in the Visual Arts Through the Eyes of Mathematics

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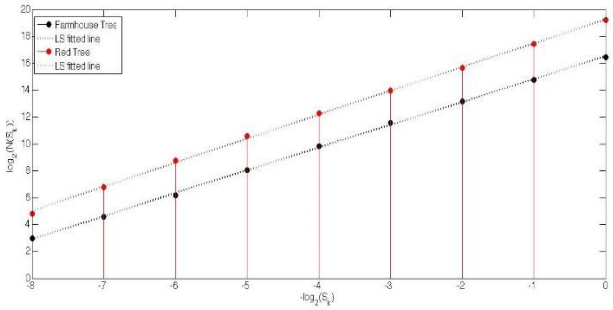
I this lecture, I started with an introduction to Fractal Geometry, a relatively new mathematical field aiming to better understand the complex structures we meet around us in Nature, not only in many inanimate objects such as coastlines, mountain ranges or cloud formations, but also objects much closer to us such as trees, plants as well as sponges, corals, even bronchial tubes in our lungs or the His-Purkinje Tree responsible for the electric conduction in the ventricles of our heart [1]! As the Mathematician Michael Barnsley eloquently put it: "Fractals are everywhere" [2]!
It is especially important to point out that these structures most often *do not have integer* (e.g., 1, 2, 3, etc.) *but fractional dimension* (e.g., 1.5, 2.4, 3.1, etc.). Their natural abundance in Nature notwithstanding, great enthusiasm was generated at the turn of the century, when Physicists presented in a paper published in Nature [3] strong evidence that many paintings of the famous American painter Jackson Pollock have *fractal properties* and possess a dimension that evolved from near 1.0 in 1943 to 1.7, by the year1953!
Many papers followed presenting positive arguments in this direction, while there was also criticism about some of the claims made by R. Taylor and his colleagues. Thus, to further test this approach, two colleagues, Prof. A.S. Fokas of Cambridge University, E. Psarakis of the University of Patras, and I, set out to apply fractal analysis to some works of another famous painter, Piet Mondrian, who lived many years before Pollock [4]. We studied the tree foliage of two well – known paintings of the Dutch master: "The Red Tree" (1910) and "Farm near Duivendrecht" (1916).
We first applied the standard "box counting" method to the paintings themselves and obtained approximate estimates of their dimension, that ranged between 1.7 and 1.8. Next, applying more sophisticated methods based on optimization techniques such as linear regression analysis, we found that the foliage in both paintings has nearly equal dimension 1.7!
Thus, based on these considerations, an intriguing question presents itself: Can we claim that the mathematical complexity of fractal shapes has an *aesthetic value of inner beauty*, able to *unconsciously* inspire great artists such as Mondrian and Pollock?

**References:**

[1] T. Bountis, "The Wonderful World of Fractals", Leader Books, Athens (in Greek), 2004.
[2] M. Barnsley, "Fractals Everywhere", Academic Press, new edition, 1993.
[3] R. Taylor, A.P. Micolich and D. Jonas, "Fractal analysis of Pollock's drip paintings", Nature, vol. 399, 422, 1999.
[4] T. Bountis, A.S. Fokas and E. Psarakis, "Fractal Analysis of Tree Paintings by Piet Mondrian (1872 – 1944)", International Journal of Arts and Technology, Vol. 10, No. 1, 27 – 42, 2017




"The Red Tree", by Piet Mondrian and the mathematical estimation of its fractal dimension (see [4]).