Bruce M. Boman, Yihan Ye, Keith Decker, Christopher Raymond, and Gilberto Schleiniger

Geometric Branching Patterns based on p-Fibonacci Sequences: Self-similarity Across Different Degrees of Branching and Multiple Dimensions,

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Abstract

Branching patterns occur throughout nature and are often described by the Fibonacci numbers. While the regularity of these branching patterns in biology can be described by the Fibonacci numbers, the branches (leaves, petals, offshoots, limbs, etc.) are often variegated (size, color, shape, etc.). To begin to understand how these patterns arise, we considered different branching patterns based on p-Fibonacci sequences. In our model, different branching patterns were created based on a specific number of decreasing-sized branches that arise from a main branch (termed the degree of branching). It was assumed that the ratio between the sizes of pairs of consecutive branches (ordered by size) equals the ratio of the largest branch size to the sum of the largest and smallest branch sizes. Generation of these branching structures illustrates that pattern self-similarities occur across different degrees of branching and multiple dimensions. Conclusion: studying geometric branching patterns based on p-Fibonacci sequences begins to show how the regularity in branching patterns might occur in biology.