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MULTI-MULTIFRACTIONAL, SCALE-FREE, SMALL-WORLD PLANAR LATTICE: ALL IN ONE

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Abstract:

We investigate a class of apparently bewildering and seemingly disordered weighted planar stochastic lattices (WPSL) and find to have a high degree of order as they display many non-trivial scaling properties.

For instance, we show that the growth of each lattice is governed by infinitely many conservation laws and each of these counter-intuitive conserved quantity results in a multifractal spectrum. Geometrically, each lattice, therefore, is multi-multifractal. On the other hand, topologically each lattice is scale-free as the degree distribution of their dual have power-law fat-tail. And at the same time they are small-world as they have a moderately high clustering coefficient C_N with numerical value independent of lattice size N while the mean geodisik path length grows logarithmically slow with N. We find that the exponent of the power-law is higher for WPSL that grows by sequential addition of triad than the WPSL that grows by sequential addition of monad. This is supported analytically by extending the Barabasi-Albert model for dyad as it represents the simplest of all group.