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The Chaotic Dynamics of Anomalous Dispersion as Modeled by a Nonstationary Extension of Brownian Motion

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We construct a family of stochastic processes with independent, nonstationary increments and arbitrary, but apriori specified mean square displacement. The family of processes is shown to be an extension of Brownian motion. If the time derivative of the variance of the process is homogeneous, then by computing the fractal dimension it can be shown that the complexity of the family is the same as that of Brownian motion. For two particles initially separated by a distance x, the finite-size Lyapunov exponent (FSLE), measures the average rate of exponential separation to a distance ax. An analytical expression is developed for the FSLE of the extended Brownian processes and numerical examples presented. The construction of the extended Brownian processes illustrates that contrary to what has been stated in the literature, a power-law mean-square displacement is not related to a breakdown in the classical CLT.