Spatiotemporal Randomness

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For a class of nonlinear chaotic maps, the exact solution can be written as $X_n = P(\theta k^n)$, where $P(t)$ is a periodic function, θ is a real parameter and k is an integer number. A generalization of these functions: $X_n = P(\theta z^n)$, where z is a real parameter, can be proved to produce truly random sequences. We have generalized these results to functions of type $X_n = h[f(n)]$. To produce complex dynamics, the function $f(n)$ does not have to be exponential all the time, and function $h(y)$ does not have to be periodic. In fact, it is sufficient for function $f(n)$ to be a finite nonperiodic oscillating function which possesses repeating intervals of truncated exponential behavior. For instance, this can be a common chaotic sequence. On the other hand, function $h(y)$ should be non-invertible. We investigate some classes of coupled map lattices. We show that, in some cases, these systems can produce completely unpredictable dynamics. We explain why some wellknown spatiotemporal systems have been found to produce very complex dynamics in numerical simulations. We discuss real physical systems that can generate random dynamics.