Colloquium

What Do Sudoku and Turbulence Have in Common?

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Wednesday, January 30 ❖ 4:00 P.M. ❖ 118 NSH

Refreshments at 3:30 P.M. in 202 NSH

The mathematical structure of many number puzzles such as Sudoku is akin to hard constraint satisfaction problems lying at the basis of applications that include protein folding and the ground-state problem of glassy spin systems. We introduce an exact mapping of Sudoku into a deterministic, continuous-time (analog) dynamical system which solves any puzzle without backtracking or random restarts. (All previous algorithms use backtracking.) We also show that the difficulty of Sudoku translates into transient turbulent behavior exhibited by this dynamical system, and that the escape rate, an invariant of transient turbulent flows, provides a scalar measure of the puzzle's difficulty that correlates well with human difficulty ratings and it can be used to define a "Richter-type" scale of puzzle hardness. Sudoku is only used as a example, the analog method presented here is applicable to all hard decision type problems (NP-complete problems) with applications both in fundamental sciences (physics, biology) and in industry (e.g., scheduling, public-key cryptography, chip design, etc).

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