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Mixing by cutting and shuffling: The effect of incorporating diffusion MENGYING WANG, IVAN CHRISTOV, Purdue Univ — Dynamical systems are commonly used to model mixing in fluid and granular flows.We consider a model one-dimensional discontinuous dynamical system (termed cutting and shuffling),and we present a comprehensive computational study of finite-time mixing.The properties of the system depend on several parameters in a sensitive way,and the effect of each parameter is examined.To improve the mixing efficiency and avoid pathological cases,we incorporate diffusion into this model dynamical system,and show it to be quite effective.Illustrative examples also show how to define the number of cutting interfaces and also a mixing norm to quantify the degree of mixing.The effect of diffusion is compared with cases which have no diffusion.We introduce fit functions for the number of cutting interfaces and the mixing norm to determined time constants of mixing for each different system considered.Systems with various different permutations (shuffling protocols) are considered,then average properties are computed.Specifically,a critical half-mixing time is identified,which leads to a rescaling of different dynamical regimes into a universal mixing behavior.This work confirms that a cut-off phenomenon also exists in discontinuous dynamical systems modeling mixing of granular materials.

Mengying Wang
Purdue Univ

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