F-P014  Learning of neural networks with different architectures

We present our study of learning of neural networks with different architectures. We use both the analytic calculation and the Monte Carlo simulation. A two-layer neural network with large $M$ hidden units learns the input-output rule generated by the target network with $M_T$ hidden units. We study the two cases; $M > M_T$ and $M < M_T$. Similar to the known case $M = M_T$, the network undergoes a first-order phase transition towards the better learning phase as the number $\alpha'$ of training sets per input unit per hidden unit increases. Before the transition occurs, the learning curves for both cases are the same as that for $M = M_T$. For $M > M_T$, $\alpha'$ at the transition point is the same as that for $M = M_T$. In the other case, the transition occurs at lower $\alpha'$. We discuss about the different learning processes for the two cases.

F-P015  Power-law Distribution of Family Names in Japanese Societies

We study the distributions of family names in Japanese societies. We define a family as a group of people who share the same family name and the size of a family $s$ as the number of people in the family. We find that (i) the total number of families, $N$, and the total population, $S$, in a society, are related as $N \sim S^{0.65}$, (ii) the number of families $n(s)$ of the size $s$ decreases as $n(s) \sim s^{-1.75}$, and (iii) the size $s$ and the rank $r$ of a family are also related as $s \sim r^{-0.75}$. These scaling properties are found to be well consistent for five different regional societies investigated. We compare our results with the cluster size distribution of two dimensional site percolation.

F-P016  Barrier Crossing of a Linear Chain

We consider the Krammers' rate of activated barrier crossing of $N(\gg 1)$ linearly coupled degrees of freedom, or a chain. Under the general framework of multi-dimensional overdamped Krammers' rate theory we calculate the barrier crossing rate for a wide range of double well potential and chain parameters. For both harmonic and anharmonic coupling within the chain, we show that the chain flexibility in the unfolded state can greatly enhance the crossing rate. Application to polymer dynamics and relation to the array-enhanced stochastic resonance are discussed.

F-P017  Bicritical Scaling Behavior in Unidirectionally Coupled Pendulums

We study the scaling behaviors of period doublings in a system of two parametrically forced pendulums with unidirectional coupling near a bicritical point corresponding to a border of chaos in both subsystems. Using both a direct numerical method and a renormalization group method, we obtain the scaling factors associated with the bicritical behaviors in both subsystems. It is thus found that the second response subsystem exhibits a new type of non-Feigenbaum scaling behavior, while the first drive subsystem is in the Feigenbaum critical state. We also note that these bicritical scaling behaviors are the same as those in the abstract system of the unidirectionally-coupled one-dimensional maps.

F-P018  Nonlinear Dynamics of A Damped Magnetic Oscillator

We consider a damped magnetic oscillator, consisting of a permanent magnet in a periodically oscillating magnetic field. A detailed investigation of the dynamics of this dissipative magnetic system is made by varying the field amplitude $A$. As $A$ is increased, the damped magnetic oscillator, albeit simple looking, exhibits rich dynamical behaviors such as symmetry-breaking pitchfork bifurcations, period-doubling transitions to chaos, symmetry-restoring attractor-merging crises, and saddle-node bifurcations giving rise to new periodic attractors. Besides
these familiar behaviors, a cascade of “resurrections” (i.e., an infinite sequence of alternating restabilizations and destabilizations) of the stationary points also occurs. It is found that the stationary points restabilize (destabilize) through alternating subcritical (supercritical) period-doubling and pitchfork bifurcations. We also discuss the critical behaviors in the period-doubling cascades.

Pitchfork bifurcation are known to be generated by the parameter of the system. The bifurcation is characterized by a doubling of the period of the oscillations. Pitchfork bifurcations are also known to be involved in the transition to chaos. The bifurcation is characterized by a sudden change in the behavior of the system. This change is due to the interaction of the system with its environment. The bifurcation is characterized by a sudden change in the behavior of the system. This change is due to the interaction of the system with its environment.

Chaotic scattering in the gravitational three-body problem is one of the fundamental problems of dynamical systems and the simplest nontrivial example of the N-body problem. The gravitational Newtonian three-body scattering problem is interesting and special due to the following properties: It is noncompact, the interaction is long range, and it is not obtainable as a small perturbation of an integrable system. In this work, we have investigated the chaotic scattering interaction between a binary star and an incoming field star. The stars are modeled as point masses and their equations of motion are numerically integrated for a number of initial conditions. The global features of the resulting initial-value space maps are presented and investigated as a function of the third star’s incoming velocity and mass.

Nonlinear Dynamics in Social Science is the study of the behavior of systems that are nonlinear. The systems are nonlinear when the output of the system is not directly proportional to the input. Nonlinear systems are often complex and can exhibit a wide range of behaviors, including chaos and turbulence.

We present some applications of nonlinear dynamics to the social science. We will consider the arms race between two countries, and the psychological interaction or conflict between two individuals, groups, or nations.

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Diffusion through the web is a complex process that occurs in many different contexts. It is a fundamental process that affects the spread of information, resources, and diseases. The diffusion process is characterized by the movement of individuals or agents from one location to another. The movement is driven by a combination of factors, including the availability of resources, the social network, and the individual’s preferences and motivations.

We study the defect dynamics which occur in vertically vibrated granular materials. Many defects - the dislocations, the domain boundaries, the sidewall foci, the spirals, and the target-like - are observed. In this work, the dimensionless acceleration $\Gamma$ is quenched from 2.5 to 3.0 and the quench time $\tau$ is changed from 0 to 12 sec. The nucleation and transition process of the defects is carefully studied and the change of pattern is analyzed by calculating the mean wave number using the structure factor. Different behaviors of the pattern selection at different $\tau$ are also studied.