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F-P014 **Learning of neural networks with different architectures** *권철안(명지대 물리학과), 김형균(명지대 물리학과)* 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 α' 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 $M > M_T$, α' at the transition point is the same as that for $M = M_T$. In the other case, the transition occurs at lower α'. We discuss about the different learning processes for the two cases.

F-P015 **Power-law Distribution of Family Names in Japanese Societies** *YOUNGKI LEE (Boston Univ.), SASUKE MIYAZIMA, TOMOMASA NAGAMINE(Chubu Univ) and HIROAKI MIYAJIMA (Ohio State Univ.)* 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** *이승균, 성우경 (포항공대 물리학과)* 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 Kramers' 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** *김상윤, 임우창 (강원대)* 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 mehtod, 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** *김상윤, 임우창 (강원대)* 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.

(F-P019) **Pitchfork 쌍갈림(Bifurcation)에 미치는 잡음효과** *김영준*, 김강현, 김기홍, 김영태 (아주대학교 물리학과)* Pitchfork 쌍갈림을 보이는 1차원 비선형 미분방정식의 종속변수에 multiplicative dichotomous noise를 인가할때 나타나는 변수의 동력학적 특성 변화를 전산시늉을 통하여 고찰하였다. noise의 강도와 상관시간이 쌍갈림 도표 및 동력학적 특성에 큰 영향을 미친다는 사실을 변수의 moment들과 확률분포를 계산하여 알 수 있었다.

(F-P020) **Chaotic scattering in the gravitational three-body problem** *정 영구, 한상준(중앙대학교 물리학과)* The 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.

(F-P021) **Nonlinear Dynamics in Social Science** *김상락(경기대학교 자연과학부)* We present some applications of nonlinear dynamics to the social science. We will consider the arms race between two contries, and the psychological interaction or conflict between two individuals, groups, or nations.

(F-P022) **수직진동하는 알갱이체의 문양 동역학에 대한 연구** *김기범, 전용근, 위행섭, 박혁규(부산대학교)* We study the defect dynamics which occurs 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 Γ is quenched from 2.5 to 3.0 and the quench time τ 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 τ are also studied.

(F-P023) **Diffusion through the web in the presence of extrinsic stochasticity** *박건영, 장충석 (한국과학기술원 물리학과)* Diffusion occurring on a connected separatrix layer(web) is analyzed where the extrinsic stochasticity is considered as a generating source for a global diffusion. The controllable parameter is suitably chosen such that the thickness of the web is infinitesimally small which excludes out the possibility of the intrinsic web diffusion. The classification of the different diffusion regimes can be identified as a function of the noise strength and in respective diffusion regime the analytical form of the diffusion coefficients can be derived from theoretical arguments which are found to agree well with numerical results. The possible applications to the problem of collisional ripple diffusion in the tokamak research are briefly discussed where it is shown that the magnitude of the ripple induced collisional loss may be somewhat higher than that estimated previously in certain parameter range.