5AM-1A (S16-1) Nonlinear Waves and Localizations

DATE: 2019/12/5 09:00–10:20
ROOM: Manhattan VI
Chairs: Yusuke Doi (Osaka University) and Masayuki Kimura (Kyoto University)

5AM-1A1 Estimation of Mobility of Discrete Breather in a Nonlinear Lattice with Long-Range Interaction

Yusuke Doi (Osaka University), Shun Hashimoto (Kyoto University), Akihiro Nakatani (Osaka University)
⇒ Proc. pp. 397–398, [Paper ID: 9186]

Mobility of discrete breather (DB) in a lattice system with long-range interaction is investigated. We estimate the mobility of DB by Peierls Nabarro (PN) potential. Nonlinear interaction coefficients that support good mobility of DB are obtained by minimizing the PN potential. Direct simulation in the lattice with the obtained coefficients shows good agreement with the estimation. The relation between the obtained lattice and symmetry of lattice is also discussed.

Keywords: Discrete Breather, Intrinsic Localized Mode

5AM-1A2 Exact Solutions of Infinite Lattices with Long-Range Nonlinear Interactions

Kazuyuki Yoshimura (Tottori University), Yusuke Doi (Osaka University)
⇒ Proc. pp. 399–402, [Paper ID: 9178]

We have found exact standing and traveling wave solutions for a class of one-dimensional infinite lattices with long-range nonlinear interactions.

Keywords: nonlinear lattice, long-range interaction, exact solution

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5AM-1A3 Anomalous Heat Spread in Pairwise Interaction Symmetric Potential Lattices

Jianjin Wang (Jiangxi Science and Technology Normal University), Daxing Xiong (Fuzhou University)
⇒ Proc. pp. 403–404, [Paper ID: 9041]

Recently a type of smooth propagation of tail free discrete breathers (DBs) has been found in pairwise interaction symmetric potential lattices. We here address the question that what are the heat spreading densities under the effects of such a kind of DBs at finite temperatures in these systems. Viewing that the full symmetric potential lattice is hard to simulate for the long-range interactions, we only consider the corresponding truncated model. By using the equilibrium fluctuation correlation method, we obtain the relevant heat spreading densities and their scaling properties. Our preliminary results indicate that the scaling exponents can change with the order of range of interactions, and more-importantly, for a large order of the range, the exponent is close to 1, suggesting that a ballistic spreading may take place.

Keywords: Discrete Breathers, Heat Spreading

5AM-1A4 Anomalous Thermal Transport in Pairwise Interaction Symmetric Potential Lattices

Jianjin Wang (Jiangxi Science and Technology Normal University), Daxing Xiong (Fuzhou University)
⇒ Proc. pp. 405–406, [Paper ID: 9056]

A particular type of one-dimensional nonlinear lattice, named as pairwise interaction symmetric potential chain, has been suggested to support smoothly propagating discrete breathers (DBs), i.e., the moving DBs. However, whether, and if yes, how these moving excitations can affect thermal transport at finite temperatures is at present an open question. Here, we employ the reverse nonequilibrium molecular dynamics method to investigate its thermal conduction behavior. Our results of the system-size dependent thermal conductivity indicates a non-ballistic anomalous divergence but with the scaling exponent obviously larger than those shown in the conventional Fermi-Pasta-Ulam chains.

Keywords: Thermal transport, discrete breathers

PSO strategy (IPSO) using particle swarm optimization (PSO) has been proposed. IPSO explores a solution space of the TSP by multiple particles, and each particle moves in the solution space by a partial path insertion method. In this paper, we first clarify problems of the partial path in- sertion method. Next, to improve the performance of IPSO, we propose an improved partial path insertion method.

Keywords: Combinatorial Optimization Problem, Traveling Salesman Problem (TSP), Particle Swarm Optimization (PSO)

5AM-1C4 **An Approximate Method Using Distance Information for Carpooling Optimization Problems**

Kosei Takahashi (Nippon Institute of Technology), Toshichika Aoki (Nippon Institute of Technology), Takayuki Kimura (Nippon Institute of Technology)
⇒ Proc. pp. 432–435, [Paper ID: 9136]

Carpooling is an effective means to reduce traffic congestion. Recently, a lot of carpool applications such as Uber and Lyft have been provided to match passengers into carpool member. These carpool applications require high speed matching of carpool group while considering distances between drivers and pick-up and exit points of passengers. We proposed grouping procedure using distance information between driver and passengers to reduce computational time. Numerical experiments show that our proposed procedure efficiently find better carpooling groups in a short time.

Keywords: Carpool Optimization Problem,Sharing System

5AM-1D (R3-1) Circuits and Systems

DATE: 2019/12/5 09:00–10:20
ROOM: Bronx III
Chair: Seiichiro Moro (Fukui University)

5AM-1D1 **Bounded Continous-Time Satisfiability Solver**

Hiroshi Yamashita (University of Tokyo), Hideyuki Suzuki (Osaka University), Zoltan Toroczkai (University of Notre Dame), Kazuyuki Aihara (University of Tokyo)
⇒ Proc. pp. 436–439, [Paper ID: 9021]

To tackle problems that can not be solved by current digital computers, many systems that use ideas in physics and neuroscience are proposed. The CTDS solver proposed by Ercsey-Ravasz and Toroczkai is one of such solvers. It solves the satisfiability problem by reducing it to a minimization of a time-varying target function. In terms of physical realization, we propose a variant of the solver with bounded target function parameters. It includes several possible modifications of the solver in system parameter differences. We also show the basic characteristics of the solver, the upper and lower bounds of the target function parameters.

Keywords: Chaos Computing, Analog Solver, Boolean Satisfiability Problem

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5AM-1D2 **Transients of Gyrator Network of Bidirectional AC/DC Converters in Peer-to-Peer Energy Transfer**

Nobuhiko Kawashima (Kyoto University), Takashi Hisakado (Kyoto University), Akmmahfuzul Islam (Kyoto University), Osami Wada (Kyoto University)
⇒ Proc. pp. 440–443, [Paper ID: 9127]

This paper describes transients of power gyrators for peer-to-peer energy transfer, which is a control strategy based on matching the source and load changes in the order of milliseconds. To realize the gyrator, bidirectional AC/DC converters are used and controlled as nonlinear gyrators in steady states. We analyze the transient behaviors of the gyrator network and show the influences of the nonlinearities with respect to the duty ratios of the gyrators.

Keywords: Peer-to-peer energy transfer, Power Gyrator, Time variable transformer, AC/DC converter

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5AM-1D3 **Design Method for Nonlinear LUT in Pseudorandom Number Generator Based on Augmented Lorenz Map**

Kiyotaka Miyauchi (Tohoku University), Yoshihiko Horio (Tohoku University), Takaya Miyano (Ritsumeikan University), Kenichiro Cho (Ritsumeikan University)
⇒ Proc. pp. 444–447, [Paper ID: 9129]

A cryptosystem using an augmented Lorenz map has been proposed. It has been shown through numerical

simulations that this chaotic map can generate statistically secure pseudorandom numbers, although high-speed hardware is necessary. One of the problems in hardware implementation is how to implement the nonlinearities in the map. In this study, we propose a method to design a look-up table (LUT) for the sine function in which we consider the distribution of argument variable. We demonstrate the possibility of high-speed and small-size implementation of a pseudorandom number generator based on the augmented Lorenz map using the proposed nonlinear LUT method.

Keywords: Hardware implementation, Look-up table, Stream cipher, Augmented Lorenz map, Pseudorandom number generator

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5PM-1A (S16-2) Nonlinear Waves and Localizations

DATE: 2019/12/5 14:20–16:40
ROOM: Manhattan VI
Chairs: Yusuke Doi (Osaka University) and Masayuki Kimura (Kyoto University)

5PM-1A1 Spectrum Analysis on Kinks in FPU Lattice with Next-Nearest-Neighbor Interaction

Kazuki Shiki (Osaka University), Yusuke Doi (Osaka University), So Nagashima (Osaka University), Akihiro Nakatani (Osaka University)
⇒ Proc. pp. 448–451, [Paper ID: 9188]

Dynamics of nonlinear waves such as kinks, solition and discrete breather (DB) in Fermi-Plasta-Ulam-β (FPU-β) lattice with Next-Nearest-Neighbor(NN) interaction is investigated. Due to the discreteness of the system deviation of discrete kink from continuum one can excite DB. Systematic simulation shows that there exist appropriate range of NN. That enhanced the excitation of DB.
Keywords: FPU lattice, Next-Nearest-Neighbor Interaction, KdV, discrete breather

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5PM-1A2 Intrinsic Localized Modes in Two-Dimensional Hexagonal Fermi-Pasta-Ulam Lattice

Yosuke Watanabe (Osaka University), Shun Izumi (Osaka University), Susumu Goto (Osaka University)
⇒ Proc. p.452, [Paper ID: 9043]

By using an iterative method for calculation, GMRES method, to a two-dimensional Fermi-Pasta-Ulam hexagonal lattice model, we obtain well-convergent numerical solutions of spatially localized nonlinear vibrational modes, stationary intrinsic localized modes (ILMs). We obtained two types of ILMs: one is linearly stable and the other is unstable and investigated their properties.
Keywords: Intrinsic Localized Modes, Hexagonal Lattice Model, Fermi-Pasta-Ulam Lattice, GMRES Method, Numerical Solutions

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5PM-1A3 Energy and Charge Transport in a Silicate Layer

Juan Archilla (Universidad de Sevilla), Yusuke Doi (Osaka University), Masayuki Kimura (Kyoto University)
⇒ Proc. p.453, [Paper ID: 9184]

It has been observed in fossil tracks and experiments in layered silicates the transport of charge through the cation layers. In this paper we present a realistic model in which a breather can trap a hole. This hole will be tight-bound to an ion and it can travel from ion to ion when they become close enough during the breather motion. The properties of such combination of breather and hole are analyzed and also, their suitability to explain the experimental data
Keywords: Silicates, charge transport, quodons

5PM-1A4 Phase Relationship of Propagating Waves in Coupled Bistable Oscillators

Kuniyasu Shimizu (Chiba Institute of Technology), Tetsuro Endo (Meiji University)
⇒ Proc. pp. 454–457, [Paper ID: 9164]

This study investigates the propagating quasi-periodic pulse waves in seven coupled bistable oscillators for weakly nonlinear case. The theoretical solutions are obtained by using the averaging method in the degenerate case. In particular, we investigate the phase relationship between the adjacent oscillators of single-mode in the theoretical solution. The associated numerical results are also shown to confirm the theoretical results.
Keywords: Coupled oscillators,Propagating wave,Averaging method

5PM-1A5 **Infinite Density for Cold Atoms in Confined Optical Lattices**

Jun Zhang (Fuzhou University), Daxing Xiong (Fuzhou University)

⇒ Proc. pp. 458–460, [Paper ID: 9093]

Infinite densities correctly describe the long-time behaviour of non-ergodic systems. The equilibrium Boltzmann-Gibbs distribution completely fails to do so. We solve the Fokker-Planck equation for cold atoms in a Sisyphus cooling lattice with an additional harmonic confinement. When diffusion constant (D) is below a critical value the solution approaches an infinite density, where D is related to the depth of the optical lattice. For large energy, we derive an explicit expression for the non-stationary phase-space distribution. Our work shows that the infinite densities plays an important role in the statistical description of cold atoms in confined optical lattices.

Keywords: Infinite densities, Fokker-Planck equation, Confined optical lattices, Ergodicity breaking

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5PM-1A6 **Analytical Solutions of Localized Modes Induced by a Receiving Coil on Resonant Circuit Array with Nearest Neighbor Coupling**

Yamato Mogi (Kyoto University), Masayuki Kimura (Kyoto University), Shinji Doi (Kyoto University)

⇒ Proc. pp. 461–464, [Paper ID: 9176]

Localized modes in resonant circuit array consisting of round coil and capacitances are investigated. When a receiving coil approaches to the resonant circuit array, a localized mode generates. We considered a simplified model of resonant circuit array, and investigated the characteristics of the localized mode with respect to overlap between the transmitting coils and diameter of the receiving coil. Finally, we revealed that several types of localized modes generate depend on the coupling among the receiving coil and the transmitting coils.

Keywords: Wireless power transfer, Resonant circuit array, Localized mode

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5PM-1B (S3-2) Laser Dynamics and Complex Photonics 2: Decision Making

DATE: 2019/12/5 14:20–16:40
ROOM: Manhattan VII
Chair: Sheng-Kwang Hwan (National Cheng Kung University)

5PM-1B1 **Dynamical Channel Selection in Wireless Communications by Multi-Armed Bandit Algorithm Using Chaotic Time Series**

Shungo Takeuchi (Tokyo University of Science), Makoto Naruse (National Institute of Information and Communications Technology), Kazutaka Kanno (Saitama University), Atsushi Uchida (Saitama University), Ma Jing (Tokyo University of Science), Mikio Hasegawa (Tokyo University of Science)

⇒ Proc. pp. 465–468, [Paper ID: 9060]

Recently, various network systems are available, and many access points and wireless base stations are deployed. However, not all access points and wireless base stations have the same performance. We propose wireless network selection by decision maker using laser chaos. The experiments were conducted on the basis of an IEEE802.11a based communication system where maximum four available channels were assumed and was performed using actual laser chaos data. We experimentally demonstrate the effectiveness of the proposed principle.

Keywords: Laser, Chaos, MAB, wireless communications, channel

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5PM-1B2 **Optimal Complex Dynamics for Solving Multi-Armed Bandit Problems Using Chaotic Time Series**

Satoshi Kochi (Kanazawa University), Tomoaki Niiyama (Kanazawa University), Atsushi Uchida (Saitama University), Makoto Naruse (University of Tokyo), Satoshi Sunada (Kanazawa University)

⇒ Proc. pp. 469–472, [Paper ID: 9067]

We report systematic numerical investigations on a decision-making model based on complex dynamics, and reveal that in multi-armed bandit problems (MAB), the probability distribution of the dynamics plays a crucial role in the accuracy and speed of the decision-making.

Keywords: decision-making, multi-armed bandit