Abstract of RIMS Symposium (open)
Dynamical Systems: Theory and Applications
RIMS 共同研究（公開型）「力学系の理論と応用」概要集

May 15, 2024

You can get the latest version of the program and the abstract from the webpage
http://saiki.hub.hit-u.ac.jp/rims2024.html

[June 3, Monday]

13:30-14:15

Speaker: Motomasa Komuro (University of Tokyo)/小室元政（東京大学）

Title: BIFURCATIONS OF COUPLED SIN-CIRCLE MAPS (6)/結合サインサークル写像の分岐について（6）

結合サインサークル写像の不動点近傍の共鳴ストリップの消滅現象を解析する。

14:30-15:15

Speaker: Isao Ishikawa (Ehime University)/石川勲（愛媛大学）

Title: 力学系から定まる局所解析汎函数上の押し出しの有限次元近似について

本講演では、力学系から定まる局所解析汎函数上の押し出し写像の有限次元近似をデータ駆動的行う理論的な枠組みについて紹介する。この枠組みによって力学系のデータ駆動解析において重要な動的モード分解（Dynamic mode decomposition; DMD）を組織的に取り扱うことが可能となり、DMD のアルゴリズムによって得られる近似行列について数学的に厳密な解釈を与えることが可能となる。応用として、ユークリッド空間上の解析的なベクトル場について、ベクトル場から定まる力学系の軌道上の離散的な点から元のベクトル場を復元する手法についても紹介する。

15:30-16:15

Speaker: Kohei Ueno (Daido University)/上野康平 (大同大学)

Title: Newton polygons and Bottcher coordinates for skew products: superattracting case and polynomial case

Let $f(z, w) = (p(z), q(z, w))$ be a superattracting or polynomial skew product of two complex variables. Under one or two conditions, we construct a Bottcher coordinate on an invariant region that conjugates f to a monomial map. For the superattracting case, the closure of the region contains the superattracting fixed point and is included in the attracting basin. The monomial map and the region are determined by the order of p and the Newton polygon of q. For the polynomial case, the region is included in the attracting basin of a superattracting fixed or indeterminacy point at infinity, or in the closure of the

attracting basins of two points at infinity. The monomial map and the region are determined by the degree of p and a Newton polygon of q.

16:25-16:50 [short communication]

Speaker: Yanghong Yu (Tokyo Institute of Technology)/余楊鴻（東京工業大学）

Title: Transition Matrix without Continuation in the Conley Index

Theory Given a one-parameter family of flows over a parameter interval Λ, assuming there is a continuation of Morse decompositions over Λ, Reineck defined a singular transition matrix to show the existence of a connection orbit between some Morse sets at some parameter points in Λ. My presentation aims to extend the definition of a singular transition matrix in cases where there is no continuation of Morse decompositions over the parameter interval. This extension will help study the bifurcation associated with the change of Morse decomposition from a topological dynamics viewpoint.

[June 4, Tuesday]

10:00-10:25 [short communication]

Speaker: Masato Hara (Kyoto University)/原誠人（京都大学）

Title: A reservoir computing method for dynamical systems on manifolds/多様体上の力学系のリザバー計算

TBA

10:35-10:55 [short communication]

Speaker: Kengo Nakai (Okayama University)/中井拳吾（岡山大学）

Title: Low-period periodic orbits model the Lorenz attractor

We investigate the effect of reservoir computing training data on the reconstruction of a chaotic attractor. We show that a time series of a few periodic orbits of low periods is sufficient to reconstruct the Lorenz attractor and that biased training data does not affect the reconstruction's success. The degree of reconstruction is much better than that of so-called cycle expansion. It is also shown that a chaotic saddle can be reconstructed by a few periodic orbits. This is a joint work with Yoshitaka Saiki.

11:05-11:50

Speaker: Tomoharu Suda (Tokyo University of Science)/須田智晴（東京理科大学）

Title: Remarks on the structure of time series data

Determining the rule of time evolution from actual observation data is a practically important problem. Essentially, time series data is a collection of finite sequences with an additional structure. In this view, reconstructing dynamics from time series data necessarily involves finding an infinite sequence (an orbit) consistent with the given data. Here, we introduce some general results on this question. We present dynamical systems and sequences as data as separate categories, and present their inter-dependence using the categorical language of functors and natural transformations. This talk is based on a joint work with S. Das.

13:30-14:50 [special talk]

Speaker: Michio Yamada (Kyoto University)/山田道夫（京都大学）

Title: TBA

15:05-16:05 [special talk]

Speaker: Hiroaki Miura (University of Tokyo)/三浦裕亮（東京大学）

Title: TBA

16:15-16:55 [special talk]

Speaker: Takuya Jinno (Toyama University)/神野拓哉（富山大学）

Title: 二次元格子モデルを用いた積雲対流の自己組織化現象についての研究

[June 5, Wednesday]

10:00-10:45

Speaker: Akio Matsumoto (Chuo University)/松本昭夫（中央大学）

Title: Delay Solow Model Revisited

This paper shows how cyclic behavior can emerge in a simple Solow capital accumulation model. For this purpose, it introduces a production delay (i.e., time-to-build) and a depreciation delay, and the resultant capital accumulation equation is a delay differential equation having delay-dependent coefficients. Then, it constructs a condition under which the interaction of the delays and the population growth rate can lead to growth cycles that are not unlike those observed in reality. In particular, it is demonstrated that (i) the production delay alone is always harmless; (ii) with a lower population growth rate, the depreciation delay alone has a destabilizing effect if it is larger than a threshold value; (iii) with a larger population growth rate, the stable steady state arises regardless of the delay length. It is further demonstrated that multiple stability switching can occur in the case of two distinct delays.

11:00-11:45

Speaker: Tomoo Yokoyama (Saitama University)/横山知郎（埼玉大学）

Title: Structural stability of "incompressible" line fields on surfaces and generic intermediate line fields

Though there is a representation that completely describes the topologies of generic flows on compact surfaces, there is no such a known representation that describes line fields (e.g., fingerprints, nematic liquid crystals, pinwheel structures in the visual field), which is a generalization of a concept of flow. In fact, one stated that there is no natural topology of the space of line fields on surfaces. In this talk, we introduce the topology generated by cone structures in the space of line fields as an analog of the topology of the space of flows to describe the structural stability of "incompressible" line fields on surfaces. We will show that, for a line field corresponding to a Hamiltonian flow, the general structure observed in the line field that appears in some phenomena is structurally stable for this topology.

13:30-14:15 [English]

Speaker: Yi-Chiuan Chen (Academia Sinica)

Title: More on the Concept of Anti-integrability for Hénon Maps

For the family of Hénon maps $(x, y) \mapsto (\sqrt{a}(1 - x^2) - by, x)$ of $\mathbb{R}^2$, the so-called anti-integrable (AI) limit concerns the limit $a \to \infty$ with fixed Jacobian b. At the AI limit, the dynamics reduces to a subshift of finite type. There is a one-to-one correspondence between sequences allowed by the subshift and the AI orbits. The theory of anti-integrability says that each AI orbit can be continued to becoming a genuine orbit of the Hénon map for a sufficiently large (and fixed Jacobian).

In this talk, we assume b is a smooth function of a and show that the theory can extended to investigating the limit $\lim_{a \to \infty} b/\sqrt{a} = \hat{r}$ for any $\hat{r} > 0$ provided that the one dimensional quadratic map $x \mapsto \frac{1}{\hat{r}}(1 - x^2)$ is hyperbolic.

(Joint work with Zin Arai, Tokyo Institute of Technology.)

14:30-15:15 [English]
Speaker: Tomoki Kawahira (Hitotsubashi University)/川平友規（一橋大学）
Title: J-stability in complex and non-Archimedean dynamics

In structurally stable dynamical systems, the chaotic locus moves continuously as the parameter changes. In the dynamics with one complex variable, we have such a continuous motion of the Julia set (chaotic locus) under a slightly weaker condition than structural stability, called "J-stability". Indeed, the bifurcation locus in the parameter space is the complement of the set of J-stable parameters.

In this talk I will give a quick survey on J-stability in the dynamics of rational functions with complex coefficients, following the works of Mañé-Sad-Sullivan (1983) and McMullen-Sullivan (1997). Then we discuss its non-Archimedean analogues recently developed in the works of Lee (2019), Benedetto-Lee (2021), and in my joint work with Junghun Lee.

15:35-16:20 [English]
Speaker: Yuto Nakajima (Tokai University)/中島由人（東海大学）
Title: On the zeros of power series

We study the set of zeros of power series. We prove that the set of zeros in the unit disk is connected and locally connected if some graphs on the sets of coefficients are connected. Furthermore, we discuss examples related to the connectedness locus for a parameter family of iterated function systems.

16:30-16:55 [short communication, English]
Speaker: Kanji Inui (Doshisha University)/伊縫 寛治（同志社大学）
Title: An example of non-ergodic measure preserving systems

In ergodic theory, given a concrete exmaple of the systems, it is sometimes difficult to prove the (non-)ergodicity of the systems. Inspired by Esaki's, Kazukawa's, and Mitsuishi's paper (Esaki, Kazukawa, and Mitsuishi (2024)), we can find an example of the non-ergodic systems obtained by a representation used in Bayesian statistics, and the representation seems especially interesting in ergodic theoretical viewpoint. In this talk, we show the non-ergodicity of the systems by the representation, and discuss the technique obtained by the representation. This is a joint work with Syota Esaki.

[June 6, Thursday]

10:00-10:25 [short communication, English]

Speaker: Yuki Yayama (Universidad del Bío-Bío)/矢山ゆき（ビオビオ大学）

Title: On Gibbs measures for almost additive potentials

Given an almost additive sequence of continuous functions with bounded variation $\mathcal{F} = \{\log f_n\}_{n=1}^{\infty}$ on a subshift X over finitely many symbols, we study properties of a function f on X such that $\lim_{n\to\infty} \frac{1}{n} \int \log f_n d\mu = \int f d\mu$ for every invariant measure μ on X. Under some conditions we construct a function f on X and study a relation between the property of $\mathcal{F}$ and some particular types of f. We also study the case when $\mathcal{F}$ is weakly almost additive. As applications we study images of Gibbs measures for continuous functions under one-block factor maps. In order to study conditions for the image to be a Gibbs measure for a continuous function, we investigate a relation between the almost additivity of the sequences associated to relative pressure functions and the fiber-mixing property of a factor map.

10:35-11:45 [special talk, English]

Speaker: Mao Shinoda (Ochanomizu University)/篠田万穂（お茶の水女子大学）

Title: Ergodic optimization for continuous functions on non-Markov shifts

13:30-14:40 [special talk, English]

Speaker: Renaud Leplaideur (Université de la Nouvelle-Calédonie)

Title: Some advances in the selection problem of measures at zero temperature

The talk will be as self-contained as possible. This is a joined work with Jairo Mengue from UFRGS. Ergodic theory in dynamical systems aims to describe almost all trajectories of some given dynamical systems. As a systems usually have many invariant measures, the thermodynamic formalism aims to select one of these measures via a variational principle. Such a measure is seen as an equilibrium. Then, ergodic optimization aims to describe how this equilibrium changes as the temperature of the system (seen as an extra-parameter) goes to zero, and what happens at the limit.

Then the talk will present in a non-technical way the question of selection and give some new results in that topic.

14:55-15:20 [short communication, English]

Speaker: Hiroki Takahasi (Keio University)/高橋博樹（慶應義塾大学）

Title: Large deviation principle and distribution of periodic points for the Dyck shift and the heterochaos baker maps

15:30-16:50 [special talk]

Speaker: Masaru Inatsu (Hokkaido University)/稲津将（北海道大学）

Title: 中高緯度大気の予測可能性

中高緯度大気はそのカオス的振る舞いのため、気象予報の限界は高々2週間程度とされている。しかし、中高緯度大気であっても予測限界が長い場合と短い場合があることが知られている。その中でも中高緯度の予測可能性に重要な因子となる大気ブロッキングをキーワードに講演者が取り組んだ2つの研究を紹介する。

　大気ブロッキングの発達の原因として低周波・高周波の渦フラックス収束の効果があるとされている。しかし、予測データにその診断をしようとすると、未来時間のデータにフィルタを適用する必要がある。研究 [2] ではまず、準地衡系で行われているモード展開法をプリミティブ系に拡張し、モード方程式を導出する。その後、Barriopedro に従い定義したブロッキング事例の合成として、ブロッキングを Z500 主成分の線型結合の持続として再定義する。これにより、導出したモード方程式によるブロッキング診断が可能になる。本研究では予測データを使わず、あくまで再解析データでの診断を行う。

　次に、大気ブロッキングを含む多様な長周期変動を自己組織化写像で生成された潜在空間上で表現し、気象予測可能性を診断した [1]。まず、解析データから基準となる潜在空間を生成する。次に、S2S プロジェクトによる各国気象機関の1か月アンサンブル予報データに射影する。潜在空間上のノードをまとめたクラスタ分析から大気状態を少数に分類することで、予測限界が長い場合と短い場合が、予報モデルによらず共通していることがわかった。これは物理的に考えられる予測可能性に一致するものと期待される。以上は、講演者が過去に行った主成分で張った相空間上での単一モデルの予測可能性研究 [3] と整合する結果である。

[1] Inatsu, M., M. Matsueda, N. Nakano, and S. Kawazoe, 2023: Prediction skill and practical predictability depending on the initial atmospheric states in S2S forecasts. Journal of Atmospheric Sciences, 80, 1449–1462.

[2] Aikawa, T., M. Inatsu, N. Nakano, and T. Iwano, 2019: Mode-decomposed equation diagnosis for atmospheric blocking development. Journal of the Atmospheric Sciences, 76, 3151–3167.

[3] Inatsu, M., N. Nakano, and H. Mukougawa, 2013: Dynamics and practical predictability of extratropical wintertime low-frequency variability in a low-dimensional system. Journal of the Atmospheric Sciences, 70, 939–952.

[June 7, Friday]

10:00-10:45

Speaker: Shousuke Ohmori (National Institute of Technology, Gunma College, Waseda University)・Yoshihiro Yamazaki (Waseda University)/大森祥輔（群馬工業高等専門学校, 早稲田大学）・山崎義弘 (早稲田大)[共同発表]

Title: Ultradiscrete Bifurcation for low-dimensional ultradiscrete dynamical systems/低次元超離散力学系の分岐構造

本発表では、分岐現象を有する低次元連続力学系に対する超離散方程式の力学的性質について、これまでの研究に対する全体的な報告を行う。発表の前半では、低次元超離散モデル（max-plus 離散力学系）が引き起こす分岐やリミットサイクルについて、相平面解析や Poincare 写像の手法を用いた解析結果を紹介する。特に離散周期軌道がリミットサイクルとなることを述べる。 超離散モデルは、連続モデルにトロピカル差分化 (正値差分化) の手法を適用して差分化した後、超離散化を施すことで得られる。そこで、発表の後半では、このトロピカル差分化によって得られる差分方程式の力学的性質に関する研究を述べる。具体的には、連続モデルからトロピカル差分化する際に起こる力学的変化についての一般論を紹介した後、トロピカル差分化から超離散状態に至る過程でのリミットサイクルの変化についてまとめた結果を、発表前半で述べた研究に紐づけながら報告する。

11:00-11:45

Speaker: Kazuyuki Yagasaki (Kyoto University)/矢ヶ崎一幸（京都大学）

Title: Semiclassical Perturbations of Single-Degree-of-Freedom Hamiltonian Systems: Separatrix Splitting and Nonintegrability

We study semiclassical perturbations of single-degree-of-freedom Hamiltonian systems and provide sufficient conditions for the separatrices to split and for their meromorphic nonintegrability such that the first integrals depend on the small parameter meromorphically. To obtain the former and latter results, we use a Melnikov-type approach and a generalization due to Ayoul and Zung of the Morales-Ramis theory, respectively. We illustrate the theoretical results for bounded potentials.

13:30-13:55 [short communication]

Speaker: Shin-itiro Goto (Chubu University)/後藤振一郎（中部大学）

Title: Derivation of a contact Hamiltonian system from the Fokker-Planck equation

The Fokker-Planck equation is a PDE known in nonequilibrium statistical mechanics, describes relaxation processes of a distribution function, and is formulated on a Riemannian manifold. Meanwhile contact Hamiltonian systems are also known to describe relaxation processes for thermodynamic variables. In this talk, to clarify a relation between these two equations, a class of contact Hamiltonian systems is shown to be derived from a class of the Fokker-Planck equations on Riemannian manifolds.

14:05-14:50

Speaker: Sogo Murakami (University of Tokyo)/村上聡梧（東京大学）

Title: Multidimensional C^0 transversality and the shadowing property for Axim A diffeomorphisms

TBA