The 7th Bremen Summer School and Symposium

**Dynamical Systems - pure and applied**

August 5-9, 2019
Faculty of Mathematics
University of Bremen
Contents

1 Schedule 1

2 List of Posters 6

3 Abstracts 8

4 Contributed Talk Abstracts 25

5 Poster Abstracts 35

6 Participants 62

ORGANISING COMMITTEE
Marc Keßeböhmer (University of Bremen)
Marcel Oliver (Jacobs University Bremen)
Sören Petrat (Jacobs University Bremen)
Anke Pohl (University of Bremen)
Jens Rademacher (University of Bremen)
Dierk Schleicher (Jacobs University Bremen / TU Berlin)

ADMINISTRATIVE CONTACT
Kathryn Lorenz (University of Bremen)
# Schedule

## Monday, August 5

**Room MZH 1470**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30-09:00</td>
<td>Registration &amp; Welcome</td>
</tr>
</tbody>
</table>
| 09:00-09:50    | Course: **Ansgar Jüngel**  
Dynamical cross-diffusion systems: modeling, analysis, numerics |
|                | Coffee break                                  |
| 10:10-11:00    | Course: **Tanja Eisner**  
Ergodic Theorems |
| 11:10-12:00    | Contributed talks                             |
|                | Lunch                                         |
| 14:00-14:30    | Talk: **Dalia Terhesiu**  
Mixing for Z Extensions of Gibbs Markov semiflows |
| 14:40-15:30    | Talk: **Julie Rowlett**  
Game theory for microbe population dynamics |
|                | Coffee break                                  |
| 16:00-16:30    | Talk: **Olga Pochinka**  
On topological classification of Morse-Smale systems |
| 16:40-17:10    | Talk: **Tanja Schindler**  
Strong laws under trimming - a comparison between iid random variables and ergodic transformations |
| 17:15-20:00    | Poster session & Reception                    |

*See page 6 for more details.*
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker/Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00-10:30</td>
<td>Course: Ansgar Jüngel Dynamical cross-diffusion systems: modeling, analysis, numerics</td>
<td>Ansgar Jüngel</td>
</tr>
<tr>
<td></td>
<td>Coffee break</td>
<td></td>
</tr>
<tr>
<td>10:10-11:00</td>
<td>Course: Tanja Eisner Ergodic Theorems</td>
<td>Tanja Eisner</td>
</tr>
<tr>
<td>11:10-12:00</td>
<td>Q &amp; A</td>
<td></td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>Talk: Martina Chirilus-Bruckner TBA</td>
<td>Martina Chirilus-Bruckner</td>
</tr>
<tr>
<td>14:40-15:30</td>
<td>Talk: Sergey Zelik Strichartz estimates and attractors for dispersive-dissipative PDEs</td>
<td>Sergey Zelik</td>
</tr>
<tr>
<td></td>
<td>Coffee break</td>
<td></td>
</tr>
<tr>
<td>15:30-18:00</td>
<td>Excursion</td>
<td></td>
</tr>
<tr>
<td>18:30-21:00</td>
<td>Conference Dinner</td>
<td></td>
</tr>
</tbody>
</table>
### Wednesday, August 7

**Room MZH 1470**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 09:00-9:50 | Course: **Tanja Eisner**  
Ergodic Theorems | p. 9 |
| 10:10-11:00 | Course: **Ansgar Jüngel**  
Dynamical cross-diffusion systems: modeling, analysis, numerics | p. 8 |
| 11:10-12:00 | Q & A                                                                  |
| 14:00-14:30 | Talk: **Charlene Kalle**  
The dynamics of flipped alpha-continued fractions | p. 14 |
| 14:40-15:30 | Talk: **Oscar Bandtlow**  
Computing Ruelle resonances of chaotic dynamical systems | p. 15 |
| 16:00-17:00 | Open Problems Session                                                  |
| 18:00-19:00 | Public lecture: **Richard Sharp**  
Paradoxical decompositions, groups and growth rates | p. 16 |
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00-9:50</td>
<td>Course: Alex Kontorovich</td>
<td>Alex Kontorovich</td>
<td>Topics in Thin Groups</td>
</tr>
<tr>
<td></td>
<td>Coffee break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:10-11:00</td>
<td>Course: Alex Kontorovich</td>
<td>Alex Kontorovich</td>
<td>Topics in Thin Groups</td>
</tr>
<tr>
<td>11:10-12:00</td>
<td>Q &amp; A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>Talk: Keivan Mallahi-Karai</td>
<td>Keivan Mallahi-Karai</td>
<td>Spectral gap for coupling of random walks on compact groups</td>
</tr>
<tr>
<td>14:40-15:30</td>
<td>Talk: Sabrina Kombrink</td>
<td>Sabrina Kombrink</td>
<td>Dynamical renewal functions</td>
</tr>
<tr>
<td></td>
<td>Coffee break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00-16:30</td>
<td>Talk: Bente Bakker</td>
<td>Bente Bakker</td>
<td>TBA</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:00-9:50</td>
<td>Course: Alex Kontorovich</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topics in Thin Groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p. 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:10-11:00</td>
<td>Coffee break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:10-12:00</td>
<td>Contributed talks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Talk: Richard Sharp</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Periodic orbit growth on covers of Anosov flows</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p. 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# List of Posters

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khadeeja Afzal</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Ali Khelil</td>
<td>Fixed point theorem for delay dynamic equations on time scales</td>
<td>36</td>
</tr>
<tr>
<td>Yuliya Bakhanova</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>Andrey Bobrovs’kiy</td>
<td>On the boundary between Lorenz attractor and quaisattractor in Shimizu-Morioka system</td>
<td>38</td>
</tr>
<tr>
<td>Tatiana Burdygina</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>Anna Dittus</td>
<td>Bifurcation analysis of a neuralnetwork in the olfactory bulb using equation-free methods</td>
<td>40</td>
</tr>
<tr>
<td>Aleksandr Gonchenko</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>Olga Gordeeva</td>
<td>About two-dimensional diffeomorphisms with a quadratic homoclinic tangency to a nonhyperbolic saddle</td>
<td>44</td>
</tr>
<tr>
<td>Anna Kolobianina</td>
<td>Classification of rough transformations of a circle from a modern point of view</td>
<td>45</td>
</tr>
<tr>
<td>Alexander Korotkov</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Christina Moor</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>Gözde Özden</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Ivan Ovsyannikov</td>
<td>Birth of discrete Lorenz attractors in global bifurcations</td>
<td>49</td>
</tr>
<tr>
<td>Nikolaos Poulis</td>
<td>Title</td>
<td>51</td>
</tr>
<tr>
<td>Habibeh Pourmand</td>
<td>Title</td>
<td>52</td>
</tr>
<tr>
<td>Karuppaiya Sakkaravarthi</td>
<td>Chimera behaviour in a Higher Dimensional Integrable Soliton Model</td>
<td>53</td>
</tr>
<tr>
<td>Evgeniya Samylina</td>
<td>Title</td>
<td>54</td>
</tr>
<tr>
<td>Ekaterina Shiryaeva</td>
<td>Title</td>
<td>55</td>
</tr>
<tr>
<td>Vijay Kumar Shukla</td>
<td>Title</td>
<td>56</td>
</tr>
<tr>
<td>Aikan Shykhmamedov</td>
<td>Strange attractors in two-dimensional and three-dimensional Henon maps</td>
<td>57</td>
</tr>
<tr>
<td>Anastasios Stylianou</td>
<td>Title</td>
<td>58</td>
</tr>
<tr>
<td>Dmitrii Sukharev</td>
<td>Title</td>
<td>59</td>
</tr>
<tr>
<td>Diaaeldin Taha</td>
<td>Title</td>
<td>60</td>
</tr>
<tr>
<td>Kalle Timperi</td>
<td>Title</td>
<td>61</td>
</tr>
</tbody>
</table>
Abstracts

Course: Mon, 9:00-9:50; Tue, 9:00-9:50; Wed, 10:10-11:00

Dynamical cross-diffusion systems: modeling, analysis, numerics

Ansgar Jüngel∗,1

ABSTRACT

∗Email address: juengel(at)tuwien.ac.at
1TU Vienna, Austria
Course: Mon, 10:10-11:00; Tue, 10:10-11:00; Wed, 9:00-9:50

Ergodic Theorems
Tanja Eisner*, 1

*Email address: eisner (at) math.uni-leipzig.de
1University of Leipzig, Germany

DYNAMICAL SYSTEMS - PURE AND APPLIED 2019
Mixing for \( Z \) Extensions of Gibbs Markov semiflows

Dalia Terhesiu\(^*\),\(^1\)

Abstract.

\(^*\)Email address: daliaterhesiu(at)gmail.com
\(^1\)University of Exeter, UK
Talk: Mon, 14:40-15:30

Game theory for microbe population dynamics

Julie Rowlett*,1

Abstract.

*Email address: julie.rowlett(at)chalmers.se
1Chalmers University of Technology, Sweden
Talk: Mon, 16:00-16:50

Strichartz estimates and attractors for dispersive-dissipative PDEs

Sergey Zelik*, 1

Abstract.
Talk: Tue, 14:00-14:30

TBA

Martina Chirilus-Bruckner*,1

Abstract.

*Email address: m.chirilus-bruckner(at)math.leidenuniv.nl
1Leiden University, The Netherlands
Talk: **Wed**, 14:00-14:30

**The dynamics of flipped alpha-continued fractions**

Charlene Kalle$^*,1$

Abstract.

---

$^*$Email address: kallecccj(at)math.leidenuniv.nl

$^1$Leiden University, The Netherlands
Talk: **Wed**, 14:40-15:30

**Computing Ruelle resonances of chaotic dynamical systems**

Oscar Bandtlow *; 1

Abstract.

---

*Email address: o.bandtlow(at)qmul.ac.uk*  
1Queen Mary University of London, UK
Public Lecture: **Wed, 18:00-19:00**

**Paradoxical decompositions, groups and growth rates**

Richard Sharp*\(^1\)

The Banach-Tarski paradox says that it is possible to decompose a 3-dimensional ball into a finite number of pieces and rearrange them to form two copies of the original ball. This is perhaps the most striking example of the type of paradoxical decompositions that were discovered in the early 20th century. It was already realised in the 1920s that these decompositions are intimately related to the structure of the underlying symmetry groups. Perhaps even more surprising, the last 60 years have seen that this theory is related to an apparently very different set of problems: understanding some of the growth (or decay) rates that occur in probability, geometry and chaotic dynamics. I will discuss some of these topics and the connections between them.

\*Email address: R.J.Sharp(at)warwick.ac.uk
\(^1\)University of Warwick, UK
Course: Thu, 9:00-9:50, 10:10-11:00; Fri, 10:10-11:00

Topics in Thin Groups

Alex Kontorovich*\textsuperscript{,1}

ABSTRACT

\textsuperscript{*Email address: alex.kontorovich(at)rutgers.edu}
\textsuperscript{1Rutgers University, USA}
Spectral gap for coupling of random walks on compact groups

Keivan Mallahi-Karai∗,1, Amir Mohammad 2, Alireza Salehi Golsefeld 2

Let $G_1$ and $G_2$ be either compact simple groups, and let $\mu_1$ and $\mu_2$ be symmetric probability measures on $G_1$ and $G_2$, respectively. Under some mild conditions on $\mu_1$, $\mu_2$, one knows that the distribution of the random walk on $G_i$ driven by $\mu_i$ converges to the uniform distribution, and the speed of convergence is governed by the spectral gap of $\mu_i$.

A coupling of $\mu_1$ and $\mu_2$ is a probability measure $\mu$ on $G_1 \times G_2$ with marginal distributions $\mu_1$ and $\mu_2$, respectively. Under what conditions does $\mu$ have a spectral gap depending on the gaps of $\mu_1$ and $\mu_2$?

In this talk I will first review some of the old and new methods for establishing spectral gaps, mainly based on pioneering work of Bourgain-Gamburd and then discuss the question stated in the previous paragraph.

∗Email address: k.mallahikarai(at)jacobs-university.de
1Jacobs University Bremen, Germany
2UC San Diego, USA
Abstract.

Dynamical renewal functions

Sabrina Kombrink∗,1

*Email address: Sabrina.Kombrink(at)mathematik.uni-goettingen.de
1University of Göttingen/University of Lübeck, Germany
Talk: Thu, 16:00-16:30

TBA

Bente Bakker *,1

Abstract.

*Email address: b.h.bakker(at)math.leidenuniv.nl
1Leiden University, The Netherlands
On topological classification of Morse-Smale systems

Olga Pochinka∗,1

Morse-Smale systems were introduced into dynamics by C. Smale [1] after the work of A. Andronov and L. Pontryagin [2], as applicants for the description of an everywhere dense class of structurally stable systems. The reality turned out to be much richer, surprising with a variety of rough systems. However, Morse-Smale diffeomorphisms and flows have unconditional value, as the simplest systems preserving their qualitative properties under small perturbations. The dynamics of these systems are called regular and it is closely related to the topology of the ambient manifold, realizing a variety of topological effects on it. A link, a knot, a wild embedding of submanifolds, all this can be illustrated on invariant sets of Morse-Smale systems. Hence it is clear that the classification of these simplest systems is not so trivial.

The report will review the existing achievements in the topological classification of Morse-Smale cascades and flows, as well as the results recently obtained, including by the author of the report [3], [4], [5].

References


∗Email address: olga-pochinka(at)yandex.ru
1HSE Nizhny Novgorod, Russia
Talk: **Thu, 17:20-17:50**

**Strong laws under trimming - a comparison between iid random variables and ergodic transformations**

Tanja Schindler*,1

Trimming, i.e. removing the largest entries of a sum of iid random variables, has a long tradition to prove limit theorems which are not valid if one considers the untrimmed sum - for example a strong law of large numbers for random variables with an infinite mean.

For certain ergodic transformations, for example piecewise expanding interval maps, and certain observables over those transformations the results are essentially the same as in the iid case. However, considering the same ergodic transformation and an observable with a different distribution function, the system can behave completely different to its iid counterpart. I will give an overview of some of the (sometimes surprising) trimming results. This is partly joint work with Marc Kesseböhmer.

---

*Email address: tanja.schindler(at)anu.edu.au
1Australian National University, Australia
Talk: Fri, 11:10-12:00

Periodic orbit growth on covers of Anosov flows

Richard Sharp*, 1, Rhiannon Dougall 1

It is well-known that the topological entropy of an Anosov flow on a compact manifold describes the exponential growth rate of its periodic orbits. If we pass to a regular cover of the manifold then we can consider a corresponding growth rate for periodic orbits of the lifted flow. This growth rate is bounded above by the original topological entropy but if the cover is infinite then the growth rate may be strictly smaller. In the important special case of a geodesic flow over a compact manifold with negative sectional curvatures, we have equality if and only if the cover is amenable (Dougall & Sharp, Math. Annalen, 2016). This result fails for general Anosov flows but we will discuss a recent result that gives a natural generalisation.

*Email address: R.J.Sharp(at)warwick.ac.uk
1University of Warwick, UK
4 Contributed Talk Abstracts

Synchronization in the networks of the second-order Kuramoto oscillators with time-varying natural frequencies

Nikita Barabash∗,1, Vladimir N. Belykh 1

In the theory of evolving dynamical networks, the Kuramoto model in its non-stationary variations (with plasticity of connections [1, 2], with switchable topology [3], with time-varying natural frequencies [4]) remains a popular example. However, despite the large number of papers devoted to this model the theory lacks of rigorous analytical results. In this talk, we present a rigorous proof of the global synchronization existence in the network of $N$ coupled second-order Kuramoto oscillators

$$\beta \ddot{\varphi}_i + \dot{\varphi}_i = \omega_i(t) + \frac{K}{N} \sum_{j=1}^{N} \sin(\varphi_j - \varphi_i), \quad i = 1, 2, \ldots, N,$$

where a positive parameter $\beta$ represents an inertia of $i$-th oscillator, $\omega_i(t)$ is a time-varying natural frequency of $i$-th oscillator, and a parameter $K$ is a coupling strength. We state our main result as follows.

**Theorem 1** Let for $K = 1$, $|\omega_i(t) - \omega_N(t)| < 2 \cos \frac{3\alpha}{2} \sin \frac{\alpha}{2}$, $i = 1, 2, \ldots, N$, $\beta < (4 \cos \frac{3\alpha}{2})^{-1}$, where $\alpha < \pi/3$. Then the global synchronization with the accuracy $|\varphi_i - \varphi_N| < \alpha$ exists in the system.

In our talk, we provide the proof of this statement as well as numerical validation.

This work was supported by the Russian Foundation for Basic Research (the project No. 18-01-00556, analytical results) and the

∗Email address: barabash@itmm.unn.ru

1Volga State University of Water Transport, Nizhny Novgorod/Lobachevsky State University of Nizhny Novgorod, Russia
Russian Science Foundation (the project No. 19-12-00367, numerical results).

References


Homoclinic orbits at bifurcations in the Circular Restricted Four Body Problem

Wouter Hetebrij*,1, Jason Mireles James 2

In the Circular Restricted Four Body Problem, we have 3 bodies in an equilateral configuration and are interested in the movement of a fourth massless body. Depending on the masses of the first three objects, there are 8, 9 or 10 Lagrangian points for the fourth body. The bifurcation diagram exists of a one-dimensional curve of Hamiltonian saddle-node bifurcations and single point where there is a subcritical Hamiltonian pitchfork bifurcation.

If there are 10 Lagrangian points, there exist homoclinic orbits to some of the stationary points of the fourth body. In this talk, we will prove that the homoclinic orbit persists at the Hamiltonian saddle-node bifurcations. We compute the homoclinic orbit in two steps.

The first step is finding a local parameterization of the two-dimensional center manifold at the bifurcation point together with its dynamics. Using the conjugate dynamics on the center manifold, we show the existence of one-dimensional stable and unstable submanifolds inside this center manifold. The second step is computing the global stable and unstable manifolds and finding an intersection of the two global manifolds.

*Email address: w.a.hetebrij(at)vu.nl
1VU Amsterdam, The Netherlands
2Florida Atlantic University, USA
Exponential stability of inertial BAM neural network with time-varying impulses and mixed time-varying delays

Rakesh Kumar*,1

The present article is investigating the effects of time-varying impulses on exponential stability to a unique equilibrium point of inertial BAM neural networks with mixed time-varying delays. A suitable variable transformation is chosen to transform the original system into the system of first order differential equation. The fixed point theory of homeomorphism has been implemented to find the distributed delay-dependent sufficient condition which assured the system has a unique equilibrium point. In order to study the impulsive effects on stability problems, the time-varying impulses including stabilizing and destabilizing impulses are considered with the transformed system. Based on the matrix measure approach and the extended impulsive differential inequality for a time-varying delayed system, we have derived sufficient criteria in matrix measure form which ensure the exponential stability of the system towards an equilibrium point for two classes of activation functions. Further, different convergence rates of the system’s trajectories have been discussed for the cases of time-varying stabilizing and destabilizing impulses using the concept of an average impulsive interval. Finally, the efficiency of the theoretical results has been illustrated by providing two numerical examples.

Keywords: Inertial BAM neural network, Time-varying impulses, Mixed delays, Matrix measure.

*Email address: rakeshk.rs.mat16@itbhu.ac.in

1Indian Institute of Technology, India
Optimal balance for geophysical flows and spontaneous wave emission

Gökce Tuba Masur*, 1, Marcel Oliver 1

To provide full understanding of a dissipation route of energy in the ocean, it is necessary to decompose geophysical flows into balanced and imbalanced components due to nonlinear coupling between the components. We know the method of optimal balance used for flow decomposition, which is introduced by Viúdez and Dritschel (2004) in the context of rapidly rotating fluid flow with Langrangian view to provide balanced initializations for geophysical flows. We, however, still do not know about quantification of imbalanced flows starting with a balanced initialization and the importance of these flows in the route to dissipation of energy. To analyse them, it is necessary to perform diagnostic derivation of balanced flows from geophysical ocean models in primitive variables. We, therefore, aim to investigate optimal balance in terms of primitive variables for the two-dimensional rotating shallow water model on $f$-plane.

In our method, the decomposition of balanced-imbalanced flows is carried out through adiabatically deforming the nonlinear rotating shallow water model into a linear one for which mode-splitting is exact, where this procedure is treated as a boundary value problem in time to be solved iteratively until converging a balanced flow. In the model implementation, all dynamics part are formulated in primitive variables while appearance of a kinematic potential vorticity inversion is inevitable owing to having robust demonstration of the method only if potential vorticity is used as a “base-point field”. After the optimal balance algorithm set-up, our search is currently moving to apply the algorithm to different scenarios and observe reasonable convergence to a balanced flow where small excitation of imbalances follows.

*Email address: g.masur(at)jacobs-university.de
1 Jacobs University Bremen, Germany

DYNAMICAL SYSTEMS - PURE AND APPLIED 2019
On Hausdorff dimension of thin nonlinear solenoids

Reza Mohammadpour*, 1, Feliks Przytycki 1, Michał Rams 1

Let $M = S^1 \times \mathbb{D}$ be the solid torus, where $S^1 = \frac{\mathbb{R}}{2\pi\mathbb{Z}}, \mathbb{D} = \{ v \in \mathbb{R}^2 | ||v|| < 1 \}$ carries the product distance $d = d_1 \times d_2$ and suppose $S : M \to M$ such that

$$(x, y, z) \mapsto (\eta(x, y, z) \mod 2\pi, \lambda(x, y, z), \mu(x, y, z))$$

is a smooth embedding map where $\eta, \lambda$ and $\mu$ are close to constant. Bothe [1] was the first who obtained results on the dimension of the attractor of a thin linear solenoid where contraction rates are strong enough. Barriera, Pesin and Schemeling [2] established a dimension product structure of invariant measures in the course of proving the Eckmann Ruelle conjecture.

Conjecture: The fractal dimension of a hyperbolic set is (at least generically or under mild hypotheses) the sum of those of its stable and unstable slices, where fractal can mean either Hausdorff or upper box dimension.

In spite of the difficulties due to possible low regularity of the holonomies, indeed, Hasselblatt and Wilkinson [4] found open sets of symplectic Anosov maps with the property that on a residual set of full measure (with respect to any invariant measure) the subbundles are not Lipschitz, and the holonomies are non-Lipschitz a.e. with respect to Lebesgue measure. Hasselblatt and Schmeling [3] have proved the conjecture for a class of thin linear solenoids. We prove the conjecture for a class of thin nonlinear solenoids.

References


*Email address: rmohammadpour(at)impan.pl
1IMPAN Warsaw, Poland

Diffusion on dynamical interbank loans networks

Nikolaos Poulisos*,1

This subject of leverage in financial networks is among the basics so as to calculate the robustness of the network. Here, in our study we use differential equations. In our research we are studying the dynamics of interbank financial networks, through the flow of capitals, leverage balancing and the stability of the network.

In the endeavor of this whole study we focus on connected and directed graphs. These graphs have some features, such as the nodes, which in our study are the banks and which therefore will be so many, as the number of total banks in any case. Another important feature is the edges, which gives the information concerning which bank provides another one with a loan. We get this information if we draw an arrow at the end of every edge and by doing this we get the direction of the way loans move from one bank to the other. In those graphs there are some fundamental tools which we are using throughout our research and these are the Adjacent, Incident and Laplacian matrices, respectively. Having all those tools we build a system of differential equations. The solution of differential equations is of the form \( \varphi(t) = e^{At}\varphi(0) \) and a very important role has the spectral analysis of operator \( A \). Moreover, we study the differential equations and their operators in order for them to be applied in understanding the financial network stability.

---

*Email address: npoulis(at)econ.uoa.gr
1National and Kapodistrian University of Athens, Greece
On Cross Sections to the Horocycle and Geodesic Flows on Quotients of SL(2, \(\mathbb{R}\)) by Hecke Triangle Groups \(G_q\), \(G_q\)-BCZ Map, and Symmetric \(G_q\)-Farey Map

Diaaeldin Taha*\(^1\)

In this talk, we explore explicit cross sections to the horocycle and geodesic flows on SL(2, \(\mathbb{R}\))/\(G_q\), with \(q \geq 3\). Our approach relies on extending properties of the primitive integers \(\mathbb{Z}^2_{\text{prim}} := \{(a, b) \in \mathbb{Z}^2 \mid \gcd(a, b) = 1\}\) to the discrete orbits \(\Lambda_q := G_q(1, 0)^T\) of the linear action of \(G_q\) on the plane \(\mathbb{R}^2\). We present an algorithm for generating the elements of \(\Lambda_q\) that extends the classical Stern-Brocot process, and from that derive another algorithm for generating the elements of \(\Lambda_q\) in planar strips in increasing order of slope. We parametrize those two algorithm using what we refer to as the symmetric \(G_q\)-Farey map, and \(G_q\)-BCZ map, and demonstrate that they are the first return maps of the geodesic and horocycle flows resp. on SL(2, \(\mathbb{R}\))/\(G_q\) to particular cross sections. Using homogeneous dynamics, we then show how to extend several classical results on the statistics of the Farey fractions, and the symbolic dynamics of the geodesic flow on the modular surface to our setting using the \(G_q\)-BCZ and symmetric \(G_q\)-Farey maps. This talk is self-contained, and does not assume any prior knowledge of Hecke triangle groups or homogeneous dynamics.

*Email address: dtaha(at)uw.edu
\(^1\)University of Washington, USA
Transitions in Dynamical Systems with Bounded Uncertainty

Kalle Timperi*1

As an alternative to stochastic differential equations, the assumption of bounded noise can offer a flexible and transparent paradigm for modelling systems with uncertainty. In particular, it offers an avenue for carrying out stability and bifurcation analysis in random dynamical systems, using a set-valued dynamics approach. The system under study is assumed to be a discrete time dynamical system in a low-dimensional Euclidian space, with bounded random kicks at each time step. The collective behaviour of all future trajectories is then represented by a set-valued map, whose minimal invariant sets represent the stable state-space regions of the system, including the effect of the noise/randomness.

We describe in the 2-dimensional case the geometric properties of minimal invariant sets, and provide a classification result for the singularity points on their boundaries. The geometry is quite well understood in this case, but becomes increasingly more complicated in higher dimensions. The geometric picture obtained serves as a stepping stone for further dynamical analysis of the systems.

In order to illuminate the loss of stability near a set-valued bifurcation, we will discuss the boundary dynamics of the minimal invariant sets, and present a numerical scheme for tracking the boundaries for changing parameter values and noise amplitudes.

*Email address: k.timperi(at)imperial.ac.uk
1Imperial College London, UK

DYNAMICAL SYSTEMS - PURE AND APPLIED 2019
5 Poster Abstracts

Title
Khadeeja Afzal*,1

Abstract.

*Email address: k.afzal(at)jacobs-university.de
1Jacobs University Bremen, Germany
Fixed point theorem for delay dynamic equations on time scales

Kamel Ali Khelil*,1, Abdelouaheb Ardjouni 2

In this work, based on the theory of calculus on time scales, we use the Krasnoselskii-Burton’s fixed point theorem to obtain asymptotic stability and stability results about the zero solution for the nonlinear delay dynamic equations on time scales. These results have important leading significance in various areas of science and engineering.

**Keywords**: Fixed point theorem, dynamic equations, time scales, stability.

**2010 Mathematics Subject Classification**: 34K20, 34N05, 45J05.

**References**


*Email address: ali.khelil.kamel(at)essg-annaba.dz
1University of Annaba, High School of Management Sciences, Algeria
2University of Souk Ahras, Souk Ahras, Algeria
Title

Yuliya Bakhanova*1

Abstract.

*Email address: bakhanovayu(at)gmail.com
1HSE Nizhny Novgorod, Russia
On the boundary between Lorenz attractor and quaisattractor in Shimizu-Morioka system

Andrey Bobrovskiy*, 1

Abstract.

*Email address: piqzo1999(at)mail.ru
1HSE Nizhny Novgorod, Russia
Title
Tatiana Burdygina*,1

Abstract.

*Email address: burdygina.tatjana(at)icloud.com
1HSE Nizhny Novgorod, Russia
Bifurcation analysis of a neural network in the olfactory bulb using equation-free methods

Anna Dittus*,1, Jens Starke 1

The olfactory bulb’s (OB) neural network with individually firing neurons in the olfactory bulb, which is responsible for odour recognition, is a good model system to study the brain’s performance because of its well-defined input and output.

For the direct interaction among cells in high-dimensional biological neural networks exist detailed models. We use a Spike and Response Model (SRM [1,2]) to simulate numerically the OB. If one considers the distinction of two different odours, both, biological measurements [3] in mammals and direct simulation, show the same macroscopic behaviour. If one odour is dominant and the concentration ration for the two odours is slightly changed, the first one’s respective area is no longer dominantly active as if the other odour was first dominant. Therefore, we consider the difference of the fire rates of their different appendant areas as the macroscopic variable. Hence, the detection of an odour depends on the fire rates in different areas of the neural network. By direct simulation, one can already get the stable branches of the fire rates. In an odour concentration/fire rate difference-diagram, hysteresis behaviour can be observed.

In order to track the unstable branches by implicit equation-free methods [4, 5], we use an altered Newton method, which deals with noisy derivative information due to the quasi-chaotic fire rates close to equal concentration.

References


*Email address: anna.dittus(at)uni-rostock.de
1University of Rostock, Germany

Title
Ksenia Fedosova* 1

Abstract.

*Email address: fedosova.xenia(at)gmail.com
1University of Freiburg in Breisgau, Germany
Title

Aleksandr Gonchenko\textsuperscript{*,1}

Abstract.

\textsuperscript{*}Email address: agonchenko(at)mail.ru
\textsuperscript{1}Lobachevsky State University of Nizhny Novgorod, Russia
About two-dimensional diffeomorphisms with a quadratic homoclinic tangency to a nonhyperbolic saddle

Olga Gordeeva\textsuperscript{*},\textsuperscript{1}

Abstract.
Classification of rough transformations of a circle from a modern point of view

Anna Kolobianina*,1

Abstract.

*Email address: akolobyanina(at)mail.ru
1Lobachevsky State University of Nizhny Novgorod, Russia
Title

Alexander Korotkov*,1

Abstract.

*Email address: koral81(at)bk.ru
1Lobachevsky State University of Nizhny Novgorod, Russia
Title
Christina Moor*,1

Abstract.

*Email address: moor(at)math.uni-bremen.de
1University of Bremen, Germany
Abstract.
Birth of discrete Lorenz attractors in global bifurcations

Ivan Ovsyannikov* \(^{,1}\)

Discrete Lorenz attractors are chaotic attractors, which are the discrete-time analogues of the well-known continuous-time Lorenz attractors. They are genuine strange attractors, i.e. they do not contain simpler regular attractors such as stable equilibria, periodic orbits etc. In addition, this property is preserved under small perturbations. Thus, Lorenz attractors, discrete and continuous, represent the so-called robust chaos.

I present a list of global (homoclinic and heteroclinic) bifurcations \([1, 2, 3, 4]\), in which it was possible to prove the appearance of discrete Lorenz attractors. The proof is based on the study of first return (Poincaré) maps, which are defined in a small neighbourhood of the homoclinic or heteroclinic cycle. The first return map can be transformed to the form asymptotically close to the three-dimensional Hénon map via smooth transformations of coordinates and parameters. According to \([1, 5, 6, 7]\), Hénon-like maps possess the discrete Lorenz attractor in an open subset of the parameter space.

References


*Email address: ivan.ovsyannikov(at)uni-hamburg.de

\(^{1}\)University of Hamburg, Germany


Title

Nikolaos Poulis*

Abstract.

*Email address: npoulios(at)econ.uoa.gr
1National and Kapodistrian University of Athens, Greece
Title

Habibeh Pourmand*, 1

Abstract.

*Email address: habibeh.pourmand(at)gmail.com
1Jagiellonian University, Poland
Chimera behaviour in a Higher Dimensional Integrable Soliton Model

Karuppaiya Sakkaravarthi*\(^1\)

In this work, we briefly revisit different types of bright multi-soliton collisions in a higher dimensional model namely the long-wave–short-wave resonance interaction system. Then we carry out a critical analysis on the occurrence of resonant and long-range interactions of the solitons. Especially, we investigate the formation and dynamics of resonant solitons/breathers/rogue-waves which exist simultaneously with standard solitons give rise to the phenomenon chimera states. Particularly for different choices of parameters, we obtain an inclined general breather, time-localized (space-periodic) Akhmediev breather, space-localized (time-periodic) Ma breather and space-time-localized rogue waves in addition to the multi-periodic waves as chimera patterns. Further, this process involves several other types of nonlinear coherent structures such as multi-state complex networks, soliton web, etc. in the intermediate state of multisoliton collisions, which can also be related to a kind of chimera behaviour.

* Email address: ksakkaravarthi(at)gmail.com
1 National Institute of Technology Tiruchirappalli, Iran
Title
Evgeniya Samylina*, 1

Abstract.

*Email address: samylina_evgeniya(at)mail.ru
1 HSE Nizhny Novgorod, Russia
Title
Ekaterina Shiryaeva*.1

Abstract.

*Email address: shiryaevae01(at)gmail.com
1Lobachevsky State University of Nizhny Novgorod, Russia
Title

Vijay Kumar Shukla*\textsuperscript{,1}

Abstract.

\textsuperscript{*}Email address: vshukla1100(at)gmail.com
\textsuperscript{1}Shivharsh Kisan P.G. College Basti, India
Strange attractors in two-dimensional and three-dimensional Henon maps

Aikan Shykhmamedov*\textsuperscript{,1}

Abstract.

\textsuperscript{*}Email address: aykansh(at)gmail.com
\textsuperscript{1}HSE Nizhny Novgorod, Russia
Title

Anastasios Stylianou*.1

Abstract.

*Email address: tasos.stylianou@warwick.ac.uk
1University of Warwick, UK
Title

Dmitrii Sukharev*\(^1\)

Abstract.

*Email address: diman25526996(at)mail.ru
\(^1\)HSE Nizhny Novgorod, Russia
Title
Diaaeldin Taha*,1

Abstract.

*Email address: dtaha(at)uw.edu
1University of Washington, Seattle, USA
Title

Kalle Timperi* 1

Abstract.

*Email address: k.timperi(at)imperial.ac.uk
1Imperial College London, UK