GRADUATE SCHOOL

MATHEMATICS OF RANDOM SYSTEMS
ANALYSIS, MODELLING AND ALGORITHMS

PROGRAM
&
ABSTRACTS

Organizing Committee: Dr Thomas Cass – (Imperial College London), **Professor Nguyen Dinh Cong** – Institute of Mathematics, VAST), **Professor Ben Hambly** – (University of Oxford), **Professor Jeroen Lamb** – (Imperial College London); **Professor Xue-Mei Li** – (Imperial College London).

Local organizer at Institute of Mathematics, VAST: Associate Professor Doan Thai Son – (Institute of Mathematics, VAST), **Dr Hoang Duc Luu** – (Institute of Mathematics, VAST and Max Planck Institute for Mathematics in the Sciences), **Associate Professor Ngo Hoang Long** – (Hanoi University of Education).

Aims: This graduate school provides a learning and interacting opportunity for PhD students and young researchers with PhD students from the EPSRC Centre for Doctoral Training "Mathematics of Random Systems" at Imperial College London and the University of Oxford. The school consists of two lectures series and a research presentations by participants and invited speakers.

Sponsors

- Activities at Imperial College London and the University of Oxford are supported by the EPSRC Centre for Doctoral Training: Mathematics of Random Systems
- Activities at Institute of Mathematics, VAST are supported by
  - International Center for Research and Postgraduate Training in Mathematics – Institute of Mathematics, Vietnam Academy of Science and Technology
  - The Simons Targeted grant to the Institute of Mathematics, VAST
  - Institute of Mathematics, VAST

Website: http://math.ac.vn/conference/GMRS2021

E-mail: rs2021@math.ac.vn

Lecture courses

1 **Prof. Dan Crisan** (Imperial College London)
Particle filters for data assimilation
The problem session is guided by **Alexander Lobbe** (Imperial College London)

2 **Prof. Franco Flandoli** (Scuola Normale Superiore di Pisa)
An introduction to random dynamical systems for climate
The problem session is guided by **Umberto Pappalettera** (Scuola Normale Superiore di Pisa)

Invited lectures

1 **Dr. Thomas Cass** (Imperial College London)
Some old and new results on the signature transform of rough path theory

2 **Prof. Benjamin Gess** (Max Planck Institute for Mathematics in the Sciences & University of Bielefeld)
Stochastic PDE, non-equilibrium fluctuations and large deviations

3 **Dr. Hoang Duc Luu** (Institute of Mathematics, VAST & Max Planck Institute for Mathematics in the Sciences)
Asymptotic stability and stationary states for stochastic systems: a pathwise approach

4 **Prof. Juan-Pablo Ortega** (Nanyang Technological University)
Reservoir computing and the learning of dynamic processes

5 **Prof. Dong Zhao** (Academy of Mathematics and Systems Science, Chinese Academy of Sciences)
To be announced

PROGRAM

(Scheduled in UK time zone)

Date Time	Monday 6 Sept.	Tuesday 7 Sept.	Wednesday 8 Sept.	Thursday 9 Sept.	Friday 10 Sept.
8:00-9:00	THOMAS CASS Invited lecture	RDS for climate Problem session	RDS for climate Problem session	RDS for climate Problem session	RDS for climate Problem session
9:00-10:00	FLANDOLI RDS for climate	CRISAN PF for DA	CRISAN PF for DA	CRISAN PF for DA	CRISAN PF for DA
10:00-11:00				PF for DA Problem session	PF for DA Problem session
11:00-11:30	Break				
11:30-12:30	T.H. Phan J. Tam	FLANDOLI RDS for climate	FLANDOLI RDS for climate	FLANDOLI RDS for climate	FLANDOLI RDS for climate
12:30-13:00	Break				
13:00-14:30	Z.P. Adams J. Yan Break	PF for DA Problem session	A. Clini V. H. Pham V. Q. Nguyen	A.Albarakati P. Platzer Break	Q. Sun A. Clini Break
14:30-15:00	Break				
15:00-16:00	M. Castro J. Sieber	JUAN-PABLO ORTEGA LAHUERTA Invited lecture	DONG ZHAO Invited lecture	LUU HOANG DUC Invited lecture	BENJAMIN GESS Invited lecture

Monday, September 6, 2021

08:00 – 09:00 **Thomas Cass** (Imperial College London)
Invited lecture *Some old and new results on the signature transform of rough path theory*

09:00 – 11:00 **Franco Flandoli** (Scuola Normale Superiore di Pisa)
Lecture *An introduction to random dynamical systems for climate*

11:30 – 12:00 **Thanh Hong Phan** (Thang Long University)
Contributed talk *Lyapunov spectrum of non-autonomous linear SDEs driven by fractional Brownian motions*

12:00 – 12:30 **Jonathan Tam** (University of Oxford)
Contributed talk *Controlled Markov chains with observation cost*

13:00 – 13:30 **Zachary P. Adams** (MPI for Mathematics in the Sciences)
Contributed talk *Asymptotic frequencies of stochastic oscillators*

13:30 – 14:00 **Jin Yan** (Queen Mary University of London)
Contributed talk *Transition to anomalous dynamics in random systems*

15:00 – 15:30 **Matheus Manzatto de Castro** (Imperial College London)
Contributed talk *Existence and uniqueness of quasi-stationary and quasi-ergodic measures for absorbed Markov processes*

15:30 – 16:00 **Julian Sieber** (Imperial College London)
Contributed talk *Geometric ergodicity and averaging of fractional SDEs*

Tuesday, September 7, 2021

08:00 – 09:00 **Umberto Pappalettera** (Scuola Normale Superiore di Pisa)
Problem session *Random dynamical systems for climate*

09:00 – 11:00 **Dan Crisan** (Imperial College London)
Lecture *Particle filters for data assimilation*

11:30 – 12:30 **Franco Flandoli** (Scuola Normale Superiore di Pisa)
Lecture *An introduction to random dynamical systems for climate*

13:00 – 14:30 **Alexander Lobbe** (Imperial College London)
Problem session *Particle filter for data assimilation*

15:00 – 16:00 **Juan-Pablo Ortega** (Nanyang Technological University)
Invited lectures *Reservoir computing and the learning of dynamic processes*

Wednesday, September 8, 2021

08:00 – 09:00 **Umberto Pappalettera** (Scuola Normale Superiore di Pisa)
Problem session *Random dynamical systems for climate*

09:00 – 11:00 **Dan Crisan** (Imperial College London)
Lecture *Particle filters for data assimilation*

11:30 – 12:30 **Franco Flandoli** (Scuola Normale Superiore di Pisa)
Lecture *An introduction to random dynamical systems for climate*

13:00 – 13:30 **Andrea Clini** (University of Oxford)
Contributed talk *Well-posedness of nonlinear diffusion equations with nonlinear conservative noise*

13:30 – 14:00 **Viet Hung Pham** (Institute of Mathematics, VAST)
Contributed talk *Persistence probability of random polynomials*

14:00 – 14:30 **Van Quyet Nguyen** (Institute of Mathematics, VAST)
Contributed talk *Partial universality of the super concentration in the Sherrington - Kirkpatricks spin glass model*

15:00 – 16:00 **Dong Zhao** (Chinese Academy of Sciences)
Invited lectures *To be announced*

Thursday, September 9, 2021

08:00 – 09:00 Problem session	**Umberto Pappalettera** (Scuola Normale Superiore di Pisa) *Random dynamical systems for climate*
09:00 – 10:00 Lecture	**Dan Crisan** (Imperial College London) *Particle filters for data assimilation*
10:00 – 11:00 Problem session	**Alexander Lobbe** (Imperial College London) *Particle filter for data assimilation*
11:30 – 12:30 Lecture	**Franco Flandoli** (Scuola Normale Superiore di Pisa) *An introduction to random dynamical systems for climate*
13:00 – 13:30 Contributed talk	**Aishah Albarakati** (Clarkson University) *Projected data assimilation using dynamic mode decomposition*
13:30 – 14:00 Contributed talk	**Paul Platzer** (Ifremer - LOPS) *Finding analogues of dynamical systems*
15:00 – 16:00 Invited lecture	**Hoang Duc Luu** (Institute of Mathematics, VAST) *Asymptotic stability and stationary states for stochastic systems: a pathwise approach*

Friday, September 10, 2021

08:00 – 09:00 Problem session	**Umberto Pappalettera** (Scuola Normale Superiore di Pisa) *Random dynamical systems for climate*
09:00 – 10:00 Lecture	**Dan Crisan** (Imperial College London) *Particle filters for data assimilation*
10:00 – 11:00 Problem session	**Alexander Lobbe** (Imperial College London) *Particle filter for data assimilation*
11:30 – 12:30 Lecture	**Franco Flandoli** (Scuola Normale Superiore di Pisa) *An introduction to random dynamical systems for climate*
13:00 – 13:30 Contributed talk	**Qiwen Sun** (Nagoya University) *Controllability of extreme events with the Lorenz-96 model*
13:30 – 14:00 Contributed talk	**Andrea Clini** (University of Oxford) *Mean-field like neural models with reflecting boundary conditions*
15:00 – 16:00 Invited lecture	**Benjamin Gess** (MPI for Mathematics in the Sciences & University of Bielefeld) *Stochastic PDE, non-equilibrium fluctuations and large deviations*

ABSTRACTS

Some old and new results on the signature transform of rough path theory

Thomas Cass[1]

Abstract: The work of Lyons (1998) introduced the general theory of rough paths and rough differential equations. A central object is the (path) signature, a non-commutative power series of iterated integrals. The seminal paper of Hambly and Lyons (2010) built upon the earlier geometric work of K-T Chen to develop the modern mathematical foundations of the theory of the signature. More recently, the signature has been used as a feature set for problems in data science.

We survey some of the mathematical underpinnings of this theory and illustrate its use through a range of recent results and applications

[1] Imperial College London, United Kingdom
Email: thomas.cass@imperial.ac.uk

Stochastic PDE, non-equilibrium fluctuations and large deviations

Benjamin Gess[1]

Abstract: Macroscopic fluctuation theory provides a general framework for far from equilibrium thermodynamics, based on a fundamental formula for large fluctuations around (local) equilibria. This fundamental postulate can be informally justified from the framework of fluctuating hydrodynamics, linking far from equilibrium behavior to zero-noise large deviations in conservative, stochastic PDE. In this talk, we will give rigorous justification to this relation in the special case of the zero range process. More precisely, we show that the rate function describing its large fluctuations is identical to the rate function appearing in zero noise large deviations to conservative stochastic PDE. The proof is based on the well-posedness of the skeleton equation – a degenerate parabolic-hyperbolic PDE with irregular coefficients, the proof of which extends DiPerna-Lions' concept of renormalized solutions to nonlinear diffusions

[1] Max Planck Institute for Mathematics in the Sciences and University of Bielefeld, Germany
Email: benjamin.gess@gmail.com

Asymptotic stability and stationary states for stochastic systems: a pathwise approach

Hoang Duc Luu[1]

Abstract: Since the pioneer work by Lyapunov, stability theory for stochastic systems has been an interesting object of mathematical research, often motivated by many applications. Under the influence of standard Brownian noises, a traditional approach assumes the existence of a Lyapunov-type function and apply the Itos formula to confirm the exponential stability of the equilibrium, hence the system is exponentially stable in the mean-square sense, which implies the exponential stability in the path-wise sense. Another geometric approach considers the Fokker Planck equation and the generated Markov semigroup, then proves the ergodicity of the unique stationary distribution by combining tools in the Γ calculus, the logarithmic Sobolev inequality, and the curvature-dimension condition to obtain exponential rate of convergence in the Kullback-Leibler divergence.

However when the driving noise is neither Markov nor semi-martingale (e.g. fractional Brownian motions), less is known on the asymptotic stability. Such systems, often called rough differential/evolution equations, can be solved either with Lyons theory of rough paths, in particular the rough integrals are understood in the Gubinelli sense for controlled rough paths, or with fractional calculus. When the noises are fractional Brownian motions, there are also Hairer's works on ergodicity of the unique stationary distribution that attracts others in the total variation norm.

In this talk, I will present an analytic approach to study the long term behavior of rough equations and the stochastic stability of its stationary states. Using the framework of random dynamical systems and random attractors, one can prove the existence and upper semi-continuity of a global pullback attractor. In particular, the techniques generalize two classical Lyapunov methods in proving exponential stability

[1] Institute of Mathematics, Vietnam Academy of Science and Technology and Max Planck Institute for Mathematics in the Sciences, Germany
Email: lhduc@math.ac.vn & Duc.Luu@mis.mpg.de

Reservoir computing and the learning of dynamic processes

Juan-Pablo Ortega[1]

Abstract: Dynamic processes regulate the behaviour of virtually any artificial and biological agent, from stock markets to epidemics, from driverless cars to health-care robots. The problem of modeling, forecasting, and generally speaking learning dynamic processes is one of the most classical, sophisticated, and strategically significant problems in the natural and the social sciences. In this talk we shall discuss both classical and recent results on the modeling and learning of dynamical systems and input/output systems using an approach generically known as reservoir computing. This information processing framework is characterized by the use of cheap-to-train randomly generated state-space systems for which promising high-performance physical realizations with dedicated hardware have been proposed in recent years. In our presentation we shall put a special emphasis in the approximation properties of these constructions.

[1] Nanyang Technological University, Singapore
Email: juan-pablo.ortega@ntu.edu.sg

Asymptotic frequencies of stochastic oscillators

Zachary P. Adams[1]

Abstract: We study stochastic perturbations of ODE with stable limit cycles – referred to as stochastic oscillators – and investigate the response of the asymptotic (in time) frequency of oscillations to changing noise amplitude.

Unlike previous studies, we do not restrict our attention to the small noise limit, and account for the fact that large deviation events may push the system out of its oscillatory regime by using the theory of quasi-ergodic measures. Our discussion recovers and improves upon previous results on stochastic oscillators.

In particular, existing results imply that the asymptotic frequency of a stochastic oscillator depends quadratically on the noise amplitude. We describe scenarios where this prediction holds, though we also show that it is not true in general – even for small noise. .

[1] Max Planck Institute for Mathematics in the Sciences, Germany
Email: zachary.adams@mis.mpg.de

Projected data assimilation using dynamic mode decomposition

Aishah Albarakati[1]

Abstract: Data Assimilation (DA) is a technique that has been used to investigate the atmosphere and ocean phenomena. DA combines observations with model output, including their uncertainty, to produce an estimate of the state of a physical system. Some challenges in data assimilation include dealing with nonlinearity, non-Gaussian error behavior, and high dimensionality of the physical system. To overcome these obstacles, we develop a projected Optimal Proposal Particle Filter (PROJ-OP-PF) based on reduced-order physical and data models. Dynamic Mode Decomposition (DMD) is a recent order reduction technique that extracts the relevant information and captures the coherent structure from the snapshot dynamic. DMD is employed to derive both reduced-order models. Projected DA and DMD techniques can be applied to a variety of physical models from discretized PDEs to medium scale ocean models. We test the efficacy of these techniques on the Lorenz'96 model (L96) and Shallow Water Equations (SWE) which are high dimensional nonlinear systems. Links to relevant manuscript: https://arxiv.org/abs/2101.09252 https://www.sciencedirect.com/science/article/abs/pii/S0898122121002121

[1] Clarkson University, United States
Email: albaraaa@clarkson.edu

Existence and uniqueness of quasi-stationary and quasi-ergodic measures for absorbed Markov processess

Matheus Manzatto de Castro[1]

Abstract: We motivate and establish the existence and uniqueness of quasi-stationary and quasi-ergodic measures for almost surely absorbed discrete time Markov processes.

[1] Imperial College London, United Kingdom
Email: m.de-castro20@imperial.ac.uk

Well-posedness of nonlinear diffusion equations with nonlinear conservative noise

Andrea Clini[1]

Abstract: We motivate and establish the pathwise well-posedness of stochastic porous media and fast diffusion equations with nonlinear conservative noise. As a consequence, the generation of a random dynamical system is obtained.

The results are based on recasting the equation in its kinetic form, a weak formulation of the PDE that allows the noise to be handled in a linear fashion, and on rough path theory. This gives rise to the central notion of 'pathwise kinetic solution'.

This type of stochastic equations arises, for example, as a continuum limit of mean field stochastic differential equations, as an approximative model for the fluctuating hydrodynamics of the zero-range particle process about its hydrodynamic limit, and as an approximation to the Dean-Kawasaki equation arising in fluctuating fluid dynamics.

[1] University of Oxford, United Kingdom
Email: andrea.clini@maths.ox.ac.uk

Mean-field like neural models with reflecting boundary conditions

Andrea Clini[1]

Abstract: Even in the absence of external sensory cues, foraging rodents maintain an estimate of their position, allowing them to return home in roughly straight lines. This computation is known as dead reckoning or path integration. Recently, a specific region of the neural cortex has been identified as the location in the rat's brain where this computation is performed, and specific mean-field type neural models have been proposed to mimic the activity of the relevant neurons in the brain. On the side of the mathematics, these models consist of systems of SDEs describing the activity level of MN neurons stacked along N columns with M neurons each. To prevent the noise from driving the activity level of some neurons to be negative, which is clearly not desirable from the point of view of the modelling, reflecting boundary conditions are added at the SDE level. When investigating the limiting behavior, these boundary conditions persist in the associated McKean-Vlasov equation and in turn translate into no-flux boundary conditions for the corresponding Fokker-Planck PDE. The combination of the spatial interaction and the interaction along columns further complicates the picture, reducing the usual properties of mutual independence of the limiting particles. We discuss and answer classical questions in the mean-field theory setting: well-posedness of the relevant systems and equations, limiting behavior, sharp estimates for the rate of convergence of empirical measures.

[1] University of Oxford, United Kingdom
Email: andrea.clini@maths.ox.ac.uk

Persistence probability of random polynomials

Viet Hung Pham[1]

Abstract: The persistence probability of a stochastic process X is defined as the probability that the process X remains positive for a long interval. We will give a brief introduction on the study on the persistence probability of celebrated random algebraic polynomials: Kac, elliptic, Weyl, Bernstein (evolutionary game theory). We recall the seminal result on Kac model by Dembo et al, predictions by Scher and Majumdar, and a powerful method given by Dembo and Mukherjee. Our main result is providing the logarithmic scale behavior of persistence probability of Weyl and Bernstein polynomials. In joint work with Van-Hao Can and Manh-Hong Duong:

https://www.cambridge.org/core/journals/journal-of-applied-probability/article/abs/persistence-probability-of-a-random-polynomial-arising-from-evolutionary-game-theory/83E0D1B3EC7EADD56B4933AF7CF7FE26
https://link.springer.com/article/10.1007/s10955-019-02298-0

[1] Institute of Mathematics, Vietnam Academy of Science and Technology
Email: pvhung@math.ac.vn

Lyapunov spectrum of non-autonomous linear SDEs driven by fractional Brownian motions

Thanh Hong Phan[1]

Abstract: We show that a linear SDE driven by a fBm generates a stochastic two-parameter flow which satisfies the integrability condition, thus the notions of Lyapunov spectrum is well-defined. The spectrum can be computed using the discretized flow and is nonrandom for triangular systems which are regular in the sense of Lyapunov. Finally, we prove a Millionshchikov theorem stating that almost all, in the sense of an invariant measure, systems are Lyapunov regular.

This is a joint work with N.D.Cong and L.H.Duc.

[1] Thanglong University, Vietnam
Email: hongpt@thanglong.edu.vn

Finding analogues of dynamical systems

Paul Platzer[1]

Abstract: Analogues (i.e. nearest neighbours) have been used in several climatic and atmospheric applications including dimensionality estimation, downscaling, interpolation and forecasting, sometimes combined with data assimilation. The issue of how longs must we wait to find a good analogue? is fundamental and has been tackled since the 1990s. Here I will present some recently published work on this topic (see published version at https://doi.org/10.1175/JAS-D-20-0382.1 and available preprint at https://arxiv.org/abs/2101.10640)

1 Ifremer - LOPS, France
Email: paul.platzer@ifremer.fr

Partial universality of the superconcentration in theSherrington-Kirkpatricks spin glass model

Van Quyet Nguyen[1]

Abstract: Consider the Sherrington-Kirkpatrick's spin glass model on complete graphs with general environments. In this talk, we will present a partial universality of the superconcentration phenomenon. Precisely, we will show that the variance of the free energy grows sublinearly in the size of its expectation when: (i) the disordered random variable, say y, has the first four moments matching to those of the standard normal distribution; or (ii) y is a smooth Gaussian functional having the symmetric law. Additionally, we also study the universality of first and second moments of the free energy of S-K models on general graphs.

This is joint work with V. H. Can and H. S. Vu.

[1] Institute of Mathematics, Vietnam Academy of Science and Technology, Vietnam
Email: Quyetnv.hnucs@gmail.com

Geometric Ergodicity and Averaging of Fractional SDEs

Julian Sieber[1]

Abstract: Consider the SDE $dX_t = b(X_t)dt + dW_t$ driven by a standard Wiener process W. It is very well known that, if b is contractive outside of a compact set, this equation has a unique invariant measure and the law converges exponentially fast in both Wasserstein and total variation distances. In this talk I will present an analogous result for W replaced by a fractional Brownian motion. This improves subgeometric rates obtained obtained in previous works. As an application of the result, I will present an averaging principle for slow-fast systems with fractional noise both in the system and the environment.

[1] Imperial College London, United Kingdom
Email: j.sieber19@imperial.ac.uk

Controllability of extreme events with the Lorenz-96 model

Qiwen Sun[1]

Abstract: The successful development of numerical weather prediction (NWP) helps better preparedness for extreme weather events. Weather modifications have also been explored, for example, when enhancing rainfalls by cloud seeding [1]. However, it is generally believed that the tremendous energy involved in extreme events prevents any attempt of human interventions to avoid or to control their occurrences. In this study, we investigate the controllability of chaotic dynamical systems by using small perturbations to generate powerful effects and prevent extreme events. The high sensitivity to initial conditions would ultimately lead to modifications of extreme weather events with infinitesimal perturbations. We also study the efficiency of the control as a function of: the amplitude of the perturbation signal, the forecast length, the localization of the perturbation signal, and the total energy. It is expected that this control method can be applied to more complicated weather systems and to other chaotic dynamical systems not limited to NWP.

References

[1] Flossmann, A. I., et al., 2019: Bull. Amer. Meteorol. Soc., 100, 1465-1480.

[1] Nagoya University, Japan
Email: qiwen.sun@riken.jp

Controlled Markov chains with observation cost

Jonathan Tam[1]

Abstract: We present a framework for a controlled Markov chain problem with observation costs. Realisations of the chain are only given at chosen observation times. We show through dynamic programming that the value function satisfies a system of quasi-variational inequalities (QVIs). We provide analysis on this class of QVIs by proving a comparison principle and constructing solutions via approximation with penalty methods. A Bayesian parametric extension to the problem is also considered. Finally, we demonstrate the numerical performances of the approximation schemes on a range of applications.

[1] University of Oxford, United Kingdom
Email: jonathan.tam@maths.ox.ac.uk

Transition to anomalous dynamics in random systems

Jin Yan[1]

Abstract: In this talk we consider a random dynamical system that samples between a contracting and a chaotic map with a certain probability p in time. We first study analytically its invariant density and Lyapunov exponents. A time-discrete Langevin equation is then generated by sums of iterates of the random system. We investigate numerically two-point correlation functions, with emphasis on the transition between an exponential decay (at $p = 1$) and a power-law decay (when p approaches 1/2).

This is a joint work with R. Klages, Y. Sato, S. Ruffo, M. Majumdar and C. Beck.

[1] Queen Mary University of London, United Kingdom
Email: j.yan@qmul.ac.uk

LIST OF PARTICIPANTS

Zachary P. Adams
Max Planck Institute for Mathematics in the Sciences
zachary.adams@mis.mpg.de

Kazu Aihara
University of Tokyo, Japan
kaihara@g.ecc.u-tokyo.ac.jp

Hassan Alkhayuon
University College Cork, Ireland
hassan.alkhayuon@ucc.ie

Aishah Albarakati
Clarkson University, United States
albaraaa@clarkson.edu

Do Tuan Anh
Ha Noi Pedagogical University 2

Nguyen Bui Thien Anh
Ho Chi Minh National Universtiy
anh.nguyen2015@qcf.jvn.edu.vn

Nguyen Van Anh
Northwestern University, United States
anhnguyen2024@u.northwestern.edu

Armand Bernou
Sorbonne Universit, France
armand.bernou@sorbonne-universite.fr

Florian Bechtold
Sorbonne Universit, France
florian.bechtold@gmail.com

Zheng Bian
University of So Paulo, Brazil
ray.bzh@gmail.com

Hamidreza Behjoo
University of Arizona, United States
hbehjoo@math.arizona.edu

Federico Bertacco
Imperial College London, UK
f.bertacco20@imperial.ac.uk

Rajendra Jagmohan Bhansali
Imperial College London, UK
sa17@liv.ac.uk

Paolo Bernuzzi
Technical University Munich, Germany
bernuzzipaolo4@gmail.com

Matthew Buckland
University of Oxford, UK
matthew.buckland@bnc.ox.ac.uk

Cao Tan Binh
Quy Nhon University, Vietnam
caotanbinh@qnu.edu.vn

Jade Ajagun-Brauns
KU Niels Bohr Institute, Denmark
jade.brauns@nbi.ku.dk

Leonardo de Carlo
Scuola Normale Superiore di Pisa, Italia
neoleodeo@gmail.com

Thomas Cass
Imperial College London
thomas.cass@imperial.ac.uk

Matheus Manzatto de Castro
Imperial College London, UK
m.de-castro20@imperial.ac.uk

Andrea Clini
University of Oxford, UK
andrea.clini@maths.ox.ac.uk

Dennis Chemnitz
Freie Universitaet Berlin, Germany
dennis@zedat.fu-berlin.de

Nguyen Ly Kieu Chinh
University of Economics
Ho Chi Minh University, Vietnam
chinhnlk@ueh.edu.vn

Hugo Chu
Imperial College London, UK
hugo.chu17@imperial.ac.uk

Lancelot Da Costa
Imperial College London, UK
l.da-costa@imperial.ac.uk

Matheus Manzatto de Castro
Imperial College London, UK
m.de-castro20@imperial.ac.uk

Nguyen Dinh Cong
Institute of Mathematics, VAST
ndcong@math.ac.vn

Nguyen Thanh Dieu
Vinh University, Vietnam
dieunguyen2008@gmail.com

Evgueni Dinvay
INRIA, France *evgueni.dinvay@inria.fr*

Le Duy Dong
University of Economics,
Ho Chi Minh University, Vietnam
dongld@ueh.edu.vn

Christopher Roberts DuPre
Georgia Institute of Technology, United States
cdupre3@gatech.edu

Dinh Quang Dung
Institute of Mathematics, VAST
dqdung999@gmail.com

Nguyen Chi Dung
Institute of Mathematics, VAST
nczung@gmail.com

Tran My Duc
Institute of Mathematics, VAST
ductranmy96gmail.com

Hong Duong
University of Birmingham, UK
h.duong@bham.ac.uk

Spencer Gales
University of Arizona, United States
sbgales@math.arizona.edu

Marti Gelrlr
Univeristy of Oxford, UK
Martin.geller@maths.ox.ac.uk

Ziad Ghauch
University of California, United States
ghauch@alumni.usc.edu

Michael Giegrich
University of Oxford, UK
michael.giegrich@st-annes.ox.ac.uk

Luca Gerolla
Imperial College London, UK

Jiajia Guo
University of Michigan, United States
jiajiag@umich.edu

Khong Van Hai
University of Nantes, France
khonghaiyp@gmail.com

Pham Hai Ha
Ho Chi Minh National University, Vietnam
phha@hcmiu.edu.vn

Hoang Thi Thu Hai
Da Nang University of Science and Education, Vietnam
hoangthithuhai1998@gmail.com

Ben Hambly
University of Oxford, UK
hambly@maths.ox.ac.uk

Can Van Hao
Institute of Mathematics, VAST
cvhao@math.ac.vn

Phan Thanh Hong
Thang Long university, Vietnam
hongpt@thanglong.edu.vn

Ruojun Huang
Scuola Normale Superiore, Italy
ruojun.huang@sns.it

Vu Thi Hue
Hanoi University of Science and Technology, Vietnam
hue.hnue@gmail.com

Pham Viet Hung
Institute of Mathematics, VAST
pvhung@math.ac.vn

Pham Thi Thu Huong
An Giang University, An Giang
ptthuong@agu.edu.vn

Phan Thi Huong
Le Quy Don Technical University, Vietnam
pthuong175@gmail.com

Philipp Jettkant
University of Oxford, UK
philipp.jettkant@maths.ox.ac.uk

Benjamin Joseph
University of Oxford, UK
benjamin.joseph@maths.ox.ac.uk

Amandine Kaiser
University of Oslo, Norway
Amandinekaiser@live.de

Trinh Mai Kien
Hanoi University of Education, Vietnam
trinhmaikien97@gmail.com

Narcicegi Kiran
Kadir Has University, Turkey
narcicegi.kiran@khas.edu.tr

Victoria Klein
Imperial College London, UK
vk1115@ic.ac.uk

Ilja Klebanov
Free University of Berlin, Germany
klebanov@zedat.fu-berlin.de

Mark Kirstein
Max-Planck-Institute for Mathematics in the Sciences, Germany
mark.kirstein@mis.mpg.de

Kolja Kypke
University of Copenhagen, Denmark
kolja.kypke@nbi.ku.dk

Jeroen Lamb
Imperial College London, UK
jsw.lamb@imperial.ac.uk

Oana Lang
Imperial College London, UK
o.lang15@ic.ac.uk

Xue-Mei Li
Imperial College London, UK
xue-mei.li@imperial.ac.uk

Long Li
INRIA, France
long.li@inria.fr

Nguyen Linh
Universite Paris-Saclay, France
nguyenhodieulinh20@gmail.com

Dan Leonte
Imperial College London, UK
dl2916@ic.ac.uk

Alexander Lobbe
Imperial College London
alexalob@math.uio.no

Ngo Hoang Long
Hanoi University of Education, Vietnam
ngolong@hnue.edu.vn

Terence Tsui Ho Lung
University of Oxford, UK
terence.tsui@sjc.ox.ac.uk

Dejun Luo
Academy of Mathematics and Systems Science, China
luodj@amss.ac.cn

Eliseo Luongo
Scuola Normale Superiore, Italia
eliseo.luongo@sns.it

Hoang Duc Luu
Institute of Mathematics, VAST
MPI for Mathematics in the Sciences
lhduc@math.ac.vn

Mirmukhsin Makhmudov
Leiden University, Netherlands
m.makhmudov@math.leidenuniv.nl

Julian Meier
University of Oxford, UK
julian.meier@maths.ox.ac.uk

Laszlo Mikolas
University of Oxford, UK
laszlo.mikolas@maths.ox.ac.uk

Nguyen Minh
University of Hawaii, United States
duyminh@hawaii.edu

Deborah Miori
University of Oxford, UK
deborah.miori@maths.ox.ac.uk

Marcello Monga
University of Oxford, UK
marcello.monga@maths.ox.ac.uk

Trinh Ngo
Ho Chi Minh University of Science, Vietnam
nlptrinh@apcs.vn

Lea Oljaca
University of Exeter, UK
oljaca@gmail.com

Christian Olivera
Universidade Estadual de Campinas, Brazil
colivera@unicamp.br

Kevin Felipe Kuhl Oliveira
Institut Polytechnique de Paris, France
kevinfkuhl@gmail.com

Wei Pan
Imperial college London, UK
wei.pan@imperial.ac.uk

Umberto Pappalettera
Scuola Nor-male Superiore di Pisa, Italy
umberto.pappalettera@sns.it

Aldair Petronilia
University of Oxford, UK
aldair.petronilia@bnc.ox.ac.uk

Paul Platzer
Ifremer - LOPS, France
paul.platzer@ifremer.fr

Nguyen Vu Trung Quan
Institute of Mathematics, VAST
quan_dl_1995@yahoo.com.vn

Nguyen Trong Quan
University of Chinese Academy of Sciences, China
quannguyen201294@gmail.com

Nguyen Van Quyet
Institute of Mathematics, VAST, Vietnam
Quyetnv.hnucs@gmail.com

Keno Riechers
Freie Universitat Berlin &
Potsdam Institute for Climate Impact Research, Germany
riechers@pik-potsdam.de

Dimitrios Roxanas
University of Sheffield, UK
d.roxanas@sheffield.ac.uk

Gianmarco Del Sarto
University of Pisa, Italia
gianmarcodelsarto@gmail.com

Korm Sambath
Cambodian
kormsambath9899@gmail.com

Yuzuru Sato
Hokkaido University, Japan
ysato@math.sci.hokudai.ac.jp

Yuriy Shulzhenko
Imperial College London, UK
ys1816@ic.ac.uk

Julian Sieber
Imperial College London, UK
j.sieber19@imperial.ac.uk

Oeng Sivkheng
Cambodian
sivkhengkh@gmail.com

Doan Thai Son
Institute of Mathematics, VAST
dtson@math.ac.vn

Vu Hong Son
Institute of Mathematics, VAST
vhson1995@gmail.com

Qiwen Sun
Nagoya University, Japan
qwenrkwork@gmail.com

Jonathan Tam
University of Oxford, UK
jonathan.tam@maths.ox.ac.uk

Thomas Tendron
University of Oxford, UK
thomas.tendron@univ.ox.ac.uk

Giuseppe Tenaglia
University of Oxford, UK
gtenaglia21@gmail.com

Wei Hao Tey
Imperial College London, UK
weihaotey@gmail.com

Tassa Thaksakronwong
Osaka University, Japan
tassa@sigmath.es.osaka-u.ac.jp

Tran Hung Thao
Institute of Mathematics, VAST
ththao@math.ac.vn

Do Minh Thang
Institute of Mathematics, VAST
thanghg99@gmail.com

Tran Van Thanh
Institute of Mathematics, VAST
tvthanh@math.ac.vn

Dinh Van Tiep
Thai Nguyen University of Technology, Vietnam
tiepdinhvan@gmail.com

Doan Khanh Thanh Tin
Vietnam
doankhanhthanhtin@gmail.com

Nguyen Van The
Hanoi National University, Vietnam
nguyenvanthe@hus.edu.vn

Pham Huu Thuan
Institute of Mathematics, VAST
huuthuan983@gmail.com

Kieu Trung Thuy
Hanoi University of Education, Vietnam
thuykt.hnue@gmail.com

Luong Duc Trong
Hanoi University of Education, Vietnam
trongsphn@gmail.com

Tran Van Trung
Quy Nhon university, Vietnam
hope.paradise94@gmail.com

Francesco Tucciarone
INRIA, France
francesco.tucciarone@inria.fr

Kalyan Teja Talluri
Imperial College London, UK
kalyan.talluri@imperial.ac.uk

Aymeric VIE
University of Oxford, UK
aymericvie78@gmail.com

Bin XIE
Shinshu University, Japan
bxie@shinshu-u.ac.jp

Zheneng Xie
University of Oxford, UK
xie@maths.ox.ac.uk

Wei Xiong
University of Oxford, UK
wei.xiong@st-annes.ox.ac.uk

Tran Dong Xuan
Duytan University
trandongxuan@gmail.com

Jin Yan
Queen Mary University of London, UK
j.yan@qmul.ac.uk

Kazuhiro Yasuda
Hosei University, Japan
k_yasuda@hosei.ac.jp

Ziheng Wang
University of Oxford, UK
ziheng.wang@queens.ox.ac.uk

Xiaofei Wu
Imperial College London, UK
xiaofei.wu@imperial.ac.uk

Fabrice Wunderlich
University of Oxford, UK
fabrice.wunderlich@maths.ox.ac.uk

Dong Zhao
Academy of Mathematics and Systems Science
Chinese Academy of Sciences
dzhao@amt.ac.cn

Huaizhong Zhao
Durham University, UK
huaizhong.zhao@durham.ac.uk

Zan Zuric
Imperial College London, UK
z.zuric19@imperial.ac.uk