Research interests
Applied Math Summer school on "The complex Math of the real world" at the Center for Mathematical Sciences, Technion, Haifa, Israel, July 2018

Dr. Chenghua Duan
Mathematics
Soochow University
Suzhou, China

I focus on constructing numerical methods by an energetic variational approach(EnVarA), which can naturally keep the physical laws, such as the conservation of mass, energy dissipation and force balance. Moreover, for problems with multiple energy laws, different numerical schemes can be developed. I am interested in solving nonlinear and degenerate systems by this method, such as Porous Medium Equation, Random Genetic Drift and Flux-saturated Diffusion Equations.

Yuval Edri
Department of Solar Energy and Environmental Physics
Ben-Gurion University of the Negev
Israel

I study forced oscillatory systems in the context of the auditory system. Specifically, we questioned the effect of having both additive and parametric forcing acting on a single self-sustained oscillator or on a spatially extended oscillatory system in 1:1 resonance. From the numerical calculations and the weakly nonlinear analysis, we gained several insights that may give alternative explanations to the measured response of the auditory hair cell to mechanical activation, or to the asymmetric profile of the basilar membrane vibrations. In this conference, I particularly find interest in synchronization of self-sustained oscillators, but also in other talks regarding pattern formation, and in the numerical and analytical analysis of partial differential equations.

Doron Elad
Mathematics
Tel Aviv University
Tel Aviv, Israel

I study problems related to electrodiffusion, physical chemistry and magnetic resonance imaging. In particular, I use a variety of tools from applied mathematics, such as mathematical modeling, asymptotic analysis, and numerical analysis, to study these topics.

Prof. Eduard Feireisl
Institute of Mathematics
Czech Academy of Sciences
Prague, Czech Republic

I study partial differential equations arising in continuum fluid mechanics, in particular, the compressible Euler and Navier–Stokes system. I am interested in the theory of generalized solutions (weak and measure–valued) with application in numerical analysis and stochastically driven fluid flows problems.

Dr. Nir Gavish
Mathematics
Technion
Israel

My current research interests are in the field of physical chemistry and electrodiffusion, particularly in ion channels and energy conversion devices. I use a combination of tools such as mathematical modeling, asymptotic and perturbation analysis, computation, and rigorous analysis, as well as collaborate with experimentalists in order to address problems.

Ms. Roni Hilel Goldshmid
Environmental Engineering
Technion-Israel Institute of Technology
Haifa, Israel

I study thermally driven atmospheric flows in complex terrains. By using scaled models with various geometries in a water tank?i.e. slope angles, lengths, roughness, plateaus, and breaking slopes?we examine the boundary layer height, separation lengths, characteristic velocities, and plume widths. These can be used in prediction models to assist in finding pollution alleviation solutions for cities located in a mountainous region.

Bnaya Gross
Physics
Bar Ilan University
Ramat Gan, Israel

I study complex networks theory, and specifically spatial embedded networks. I study how the spatial embedding affects the behavior of the network. Our field includes the following mathematical topics: percolation theory, branching process, epidemics,phase transitions, random graphs, statistical physics.

Dr. Habiba V. Kalantarova
Mathematics
Technion
Israel

I study partial differential equations using tools from functional analysis and harmonic analysis. My current research is focused on the surface diffusion model of groove evolution and its special solutions.

Dr. Miroslav Kramár
Mathematics
INRIA Saclay
France

I use topological methods to study non-linear dynamical systems. My research is conducted in close collaboration with the theoretical and experimental physics community as well as biologists and chemist. In my recent work I have been analyzing large data sets produced by sampling of orbits in various complex spatio-temporal systems such as fluid flows, granular materials and deforming thin wall structures. The main focus of the analysis is on understanding the dynamical structures and predicting the future behaviour of the systems.

Pavel Kravetc
Mathematics
The University of Texas at Dallas
TX, USA

I study dynamical systems that exhibit complex behavior due to the symmetries, delay and non-smoothness. In particular, my current research interests include but are not limited to Hopf bifurcations of relative periodic solutions in systems of functional differential equations with finite symmetries, stabilization of periodic solutions, chaotic behavior in piecewise-smooth maps. The applications are found in Laser and Population dynamics, Control, Mathematical Economics and Mechanical Models with Friction.

Mr. Prosenjit Kundu
Mathematics
National Institute of Technology Durgapur
Durgapur, India

Synchronization in phase-frustration systems: Synchronizing phase frustrated Kuramoto oscillators, a challenge that has found applications from neuronal networks to the power grid, is an eluding problem, as even small phase-lags cause the oscillators to avoid synchronization. We investigate transition to synchrony in degree-frequency correlated phase-frustarted model on complex networks both analytically and numerically. We derive self-consistent equations for group angular velocity and order parameter for the model in the thermodynamic limit. Using the self-consistent equations we try to investigate transition to synchronization (continuous or discontinuous) in SK model on uncorrelated scale-free (SF) and Erdos-Rényi (ER) networks. Also we try to find out an answer how to strategically select the optimal frequency set, capturing the natural frequencies of all oscillators, for a given network and phase-lags, that will ensure perfect synchronization. We also investigate how high levels of synchronization are sustained in the vicinity of the optimal set, allowing for some level of deviation in the frequencies without significant degradation of synchronization.

Symmetry breaking/steady states in oscillatory networks: From embryonic development to the appearance of vegetation patches, the formations of pattern can spontaneously emerge in structure less, homogeneous systems. The ubiquity of this phenomena in nature, suggests that it can appear under rather general. Hence we began with a system representing a most general class of networked dynamics, and derived the conditions under which it can lead to the formation of patterns. We found that by adding a small amount of dynamic repulsive links, can undergo a bifurcation from a homogeneous steady state, in which identical pattern is observed, to an in-homogeneous steady state, where despite the uniformity of the underlying network and initial conditions, nodes reside to different states, marking the formation of a pattern in the system.

Prof. Chun Liu
Mathematics
Illinois Institute of Technology
Chicago, USAl

I study spatiotemporal nonlinear dynamics of thin liquid films falling down solid surfaces as plane and cylinder, static and periodically oscillating, both. I also study stability of the flat time-periodic base flow using Floquet theory. I interested in numerical analysis and numerical methods. I also interested in mathematical models, asymptotic problems, CFD, and bifurcation analysis.

Professor Robert McCann
Mathematics
University of Toronto, Canada

I study optimal transportation and its applications to physics, economics and geometry. At the moment I am creating a synthesis between metric-measure geometry and Einstein's theory of general relativity, based on the equivalence of the fact that gravity acts purely attractively and never repulsively with the convexity of Boltzmann's entropy along all future-directed timelike geodesics of probability measures on spacetime.

Prof. Baruch Meerson
Racah Institute of Physics
Hebrew University of Jerusalem
Jerusalem, Israel

My current interests are in the theory of large fluctuations in macroscopic systems, including dynamics of stochasic populations. My previous research embraced a broad variety of subjects in granular dynamics, phase ordering dynamics, fluid mechanics, plasma physics and quantum chaos.

Prof. Alexander Nepomnyashchy
Mathematics
Technion
Haifa, Israel

My research fields are applications of nonlinear dynamics in physics, including instabilities and pattern formation in fluids, interfacial phenomena, microgravity phenomena, nonlinear optics, anomalous diffusion and dispersion.

Dr. Elena Novbari
Computer Science
Technion
Haifa, Israel

I study spatiotemporal nonlinear dynamics of thin liquid films falling down solid surfaces as plane and cylinder, static and periodically oscillating, both. I also study stability of the flat time-periodic base flow using Floquet theory. I interested in numerical analysis and numerical methods. I also interested in mathematical models, asymptotic problems, CFD, and bifurcation analysis.

Prof. Amy Novick-Cohen
Mathematics
Technion
Haifa, Israel

My current interests include fourth order parabolic problems and systems, especially surface diffusion, with emphasis on and degenerate problems of this sort, and their use in modelling and applications as regards phase transitions, wetting and dewetting.

Prof. Arkady Pikovsky
Physics
University of Potsdam
Germany

My field is nonlinear and statistical physics. My current interests are in the theory of synchronization of coupled oscillating dynamical units, noise-induced effects in the dynamics of nonlinear systems, and pattern formation. On the applied side, we develop inverse methods allowing to reconstruct the dynamical properties of oscillators and their interaction from observations.

Gautam Pai
Computer Science
Technion
Haifa, Israel

I study numerical algorithms for geometry processing. I am particularly interested in exploring numerical solutions to PDE?s on geometric surfaces (triangulated meshes or otherwise) along with topics from manifold learning, metric learning and geometric signal processing. My PhD is focused on exploring tools from machine learning to solve and understand some of these problems.

Prof. Len Pismen
Chemical Engineering
Technion
Haifa, Israel

I have worked in the various areas of nonlinear physics, as well as in applications of nonlinear dynamics to catalysis, fluid flows, and surface phenomena. My latest research is in mechanics of soft matter, including its biological applications. I am particularly interested in properties and dynamics of singularities and topological defects in the various settings.

Monisha Renganathan
Applied Mathematics
University of Manchester
Manchester, UK

My project involves the mathematical modelling of diffusion-driven oxidation in some metals. It is aimed at providing a predictive quantitative description for the formation of an oxide layer on a metal surface. Oxidation in pure oxygen, pure moisture and humid air are of interest. The kinetic properties of these oxidation reactions have been studied in the past and empirical models describing the rates of reaction have been proposed. With the exception of quite a few, these models are empirical in nature. My project aims at providing a mathematical description of the oxidation process. Oxidation is through ionic diffusion of the oxide anions (in pure oxygen) and hydroxyl and oxygen anions (in humid air). The overall process is thus one of combined temperature- and time-dependent (among several other factors) chemical and ionic diffusion. It is vital that the dominant physical mechanisms are well modelled to provide both a qualitative understanding and a quantitative predictive capability for long-term material ageing.

Dr. Aaron J. Rosengren
Aerospace and Mechanical Engineering
University of Arizona
Tucson, USA

I study the evolution of artificial and natural celestial bodies with the overall intent being to identify, classify, and understand the dominant mechanisms affecting their motions. At the core lies the application of the mathematical and numerical tools and techniques of dynamical systems theory (i.e., from the determination of effective averaged models more amenable to analytical and/or numerical investigations to the construction of resonant normal forms, including modern dynamical chaos indicator to visualize phase-space regularity). I am also interested in more practical issues of space debris modeling, mitigation and remediation.

Hillel Sanhedrai
Physics
Bar Ilan University
Ramat Gan, Israel

I study complex networks theory, and specifically revivability of nonlinear dynamics in random networks. Our field includes the following mathematical topics: percolation theory, branching process, epidemics, nonlinear dynamics, phase transitions, random graphs, statistical physics.

Kateryna Stiepanova
Mathematics
KhNUE
Kharkiv, Ukraine

I study the qualitative properties of solutions to initial-boundary value problems for wide classes of nonlinear parabolic equations of the second and higher orders. The most important aspect of my investigations is the description of structural conditions affecting the appearance and disappearance of various non-linear phenomena (such as strong and weakened localization of solutions, extinction of solutions in finite time, etc.). My poster deals with semi-linear parabolic equation with degenerating absorption potential $a_0(x)$, the presence of which play the important role in the study of the above mentioned properties.

Mr. Almog Shani-Zerbib
Faculty of Civil and Environmental Engineering
Technion
Haifa, Israel

I am currently working on my PhD study of water waves evolution under wind forcing. I practice laboratory and field measurements in this matter at the T-SAIL (Technion Sea Atmosphere Interaction Research Laboratory) facilities. I am also interested in image processing-type applications of fluid dynamics and wave breaking detection via particle tracking velocimetry (PTV).

Dr. Jim Thomas
Woods Hole Oceanographic Institution and
Department of Oceanography, Dalhousie University

My research is inspired by the wide range of wave fields that arise in fluid flows, such as surface gravity waves, internal gravity waves, and acoustic waves. My work is aimed at developing a fundamental understanding of how theses waves are affected by changes in the medium and the mean flow through which they propagate. Using asymptotic analysis and high resolution direct numerical simulations, I develop theories that can explain how waves and vorticity fields interact in fluid flows.

Dr. Alexandru Vreme
T-SAIL, Civil & Environmental Engineering
Technion – Israel Institute of Technology
Haifa, Israel

My current research interests are orbiting around coupled wind-ocean waves interactions. More concisely in the investigation of breaking waves phenomenon, its detection, and breakers classification. I'm trying to achieve this goal using a combination between Phase Time Method, wavelet analysis, and pattern recognition tool.
Secondary, but not less challenging is the study of ingestion or desorption of carbon dioxide in aqueous solutions with associated chemo-convection and hydrodynamical instabilities.

Yifan Zhang
Department of Mathematics
University of Science and Technology of China
Hefei, China

I am interested in numerical solutions of conservation laws and in general convection dominated problems using both Essentially non-oscillatory (ENO) methods and weighted ENO (WENO) methods.