Colloquium

**Topic:** Content-Aware Image Restoration for Light and Electron Microscopy

**Date:** 27.01.20

**Time:** 16:15

**Place:** H6

**Guest:** Dr. Florian Jug

Max Planck Institute of Molecular Cell Biology and Genetics, Dresden

In recent years, fluorescent light microscopy and cryo-electron microscopy saw tremendous technological advances. Using light microscopes, we routinely image beyond the resolution limit, acquire large volumes at high temporal resolution, and capture many hours of video material showing processes of interest inside cells, in tissues, and in developing organisms. Cryo-electron microscopes, at the same time, are capable of visualizing cellular building-blocks in their native environment at close to atomic resolution. Despite these possibilities, the analysis of raw images is usually non-trivial, error-prone, and cumbersome. Here we show how machine learning, i.e., neural networks, can help to tap the full potential of raw microscopy data by applying content-aware image restoration (CARE) techniques. Several examples in the context of light microscopy (LM) and cryo-electron microscopy (EM) illustrate how downstream analysis pipelines lead to improved (automated) results when applied to content-aware restorations. While our recently published results on LM data [1] do profit from the fact that single high-quality, low-noise acquisitions can directly be recorded, in other occasions, this is not possible (e.g., for cryo-EM). Hence, we developed CARE variations [2,3,4] that do not require the acquisition of high-quality examples but can be trained from noisy images alone. [1] M Weigert, U Schmidt, et al.; Content-aware image restoration: pushing the limits of fluorescence microscopy; bioRxiv, 236463 [2] TO Buchholz, M Jordan, G Pigino, F Jug; Cryo-CARE: Content-Aware Image Restoration for Cryo-Transmission Electron Microscopy Data; ISBI’19; preprint: arXiv:1810.05420 [3] A Krull, TO Buchholz, F Jug; Noise2Void-Learning Denoising from Single Noisy Images; CVPR’19, preprint: arXiv:1811.10980 [4] A Krull, T Vicar, F Jug; Probabilistic Noise2Void: Unsupervised Content-Aware Denoising; arXiv arXiv:1906.00651 [eess.IV]

**Contact**
Resonances of Riemannian manifolds are of great importance in many areas of mathematics and physics. Even though many fascinating results about these spectral entities have already been found, an enormous amount of their properties, also some very elementary ones, is still undiscovered. A few years ago, by means of numerical experiments, Borthwick noticed for some classes of Schottky surfaces (certain hyperbolic surfaces of infinite area) that their sets of resonances exhibit unexcepted and nice patterns, which are not yet fully understood. After a survey of some parts of this field, we will discuss an alternative numerical method, combining tools from dynamics, zeta functions, transfer operators and thermodynamic formalism, functional analysis and approximation theory. This is joint work with Oscar Bandtlow, Torben Schick and Alexander Weiße.
Guest: Olga Soloveva

FIAS Frankfurt

Transport properties of the quark-gluon plasma in a hot and dense QCD medium have been studied. We have calculated transport coefficients for massive interacting quasi-particles with non-zero widths described by the Dynamical Quasi-Particle Model (DQPM). The DQPM enable to calculate the quark and gluon collisional interaction rates using the cross-sections. Transport coefficients have been estimated using the collisional interaction rates as an inverse relaxation time on the base of the relaxation time approximation (RTA). We compute the ratio of the shear and bulk viscosities to the entropy density, i.e. $\eta/s$ and $\zeta/s$, the electric conductivity $\sigma_0/T$, as well as the baryon diffusion coefficient $\kappa_B$ and compare to related approaches from the literature (lattice QCD, NJL, ADS/CFT). We find that the ratios $\eta/s$ and $\zeta/s$ as well as $\sigma_0/T$ are in accord with the results from lattice QCD at $\mu_B=0$ and only weakly depend on the ratio $T/T_c(\mu_B)$ where $T_c(\mu_B)$ denotes the critical temperature at finite baryon chemical potential.

Contact person: W. Unger

Seminar Condensed Matter

Topic: Multiple-scale stochastic processes: decimation, averaging and beyond

Date: 30.01.20

Time: 14:15

Place: D5-153

Guest: Stefano Bo

MPI for the Physics of Complex Systems

Many systems of interest involve processes taking place on widely separated time scales. For an efficient modeling one usually focuses on the slower degrees of freedom and it is of great importance to accurately eliminate the fast variables in a controlled fashion, carefully accounting for their net effect on the slower dynamics. Multiple-scale techniques provide a systematic approach to this task. I will present such procedures and discuss their application to some stochastic systems of physical, biological and chemical relevance. I will then consider functionals of the stochastic trajectories such as residence times, counting statistics, fluxes, entropy production, etc.. For such functionals, the elimination of the fast degrees of freedom can
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Contact person: Peter Reimann

Seminar Mathematical Physics

**Critical behaviour and characteristic polynomials of non-Hermitian random matrices**

Topic: Non-Hermitian random matrices

Date: 23.05.19

Time: 16:15

Place: D5-153

Guest: Nicholas Simm

University of Sussex

I will discuss some recent developments regarding the normal matrix model. In particular my interest will be in certain critical models where the limiting support of the eigenvalues can radically change its topology by slightly adjusting an external parameter. I will discuss how aspects of the model can be explicitly mapped to the study of expectations of characteristic polynomials of non-Hermitian random matrices (e.g. Ginibre or truncated unitary). Many of these averages are related to Painlevé transcendents, and by exploiting this, a precise and non-trivial asymptotic expansion of partition functions can be calculated in the critical models. This is joint work with Alfredo Deaño (University of Kent).

Contact person: Gernot Akemann

Seminar AG Zufallsmatrizen

**Dimensional reduction for elliptic SPDE's: integrable structures and large deviations**

Topic: Dimensional reduction for elliptic SPDE's
I will review the phenomenon of dimensional reduction for elliptic stochastic PDE's in two and three dimensions due to hidden supersymmetry discovered by Parisi and Sourlas. I will use dimensional reduction to establish a link between matrix-valued elliptic SPDE's and determinantal point processes. I will show that the large deviations principle can be established for a class of equations without any reference to supersymmetry. The talk is based on joint work with Roger Tribe and David Elworthy.