PETER MÜHLBACHER

+43 660 3409620
peter@muehlbacher.me
peter.muehlbacher.me
github.com/petermuehlbacher

Education

Bachelor, University of Vienna, Mathematics — 2012–2016
Master, University of Cambridge — 2016–2017

Papers

Bounding the Largest Eigenvalue of Generalised Wigner Matrices
joint work with L. Erdős (yet to appear)

Elliptic Curve Cryptography
won the Dr. Hans-Riegel award worth 600€

Diffusion Maps
my first Bachelor's thesis on dimensionality reduction and numerical methods for stochastic partial differential equations

High Dimensional Landscapes and Random Matrices
my second Bachelor's thesis on large deviations of spectral statistics and their applications to spin glasses and neural networks

Protein Docking
focus on implementation and numerics

Continuum Random Trees
Part III essay, supervised by J. Miller

Languages

- German — native speaker
- English — C2 (CAE)
- French — 5 years in school
- Russian — 3 years in school
- Japanese — 3 years, self study
- Chinese — 1 year, self study

Programming

Hands-on experience with Python (protein docking, sound visualisation), Mathematica (internship at the IQOQI), Java (data visualisation, visual arts) and smaller projects at university with Matlab.

Extracurricular Activities

Internships at the *Institute for Science and Technology Austria* (L. Erdős' group) and the *Institute for Quantum Optics and Quantum Information* (R. Ursin's group) as well as participation in the *Summer School Alpbach 2015* on quantum physics.

I worked as a paramedic, full-time from July, 2013 to March, 2014, and on a voluntary basis afterwards until I left Austria for my Master's (2016).

Scholarships

- **OeAD research work — 2016, 2200€**

Part III courses:

- Advanced Probability
- Mixing Times of Markov Chains
- Percolation & Random Walks
- Compressed Sensing & Sampling
- Stochastic Calculus & Applications
- SLEs
- Gaussian Processes
- Topics in Random Graphs

Research Papers (with comments)

Bounding the Largest Eigenvalue of Generalised Wigner Matrices

Aim of the paper: We present a proof for an improved upper bound on the expectation of the largest eigenvalue of a class of random matrices (essentially Wigner, but without the iid assumption).

Original contribution: From a recursion relation for the diagonal entries of powers of the matrix in question (derived by Erdős et al.) we derive a correspondence between trees and summands of the trace (without lower order error terms which one would get by naïvely generalising the standard moment method proof). We improve the existing bound (derived by Stieltjes transform techniques) by getting statistics on the distribution of lengths of distinct branches in trees of fixed length. Using coupling techniques and the bijection between trees and Dyck paths we go on to reduce this problem to computing the expectation of functionals of up-runs in fair coin tosses (which has already been dealt with in existing literature).

Current state: The paper is in its final stage of being written up.

Decoherence of Entanglement in a Gravitational Field

Aim of the paper: A space mission proposal for ESA geared towards proving/disproving a non-standard model introduced by T.C. Ralph and J. Pienaar.

Original contribution: Apart from other people's contributions which I could hardly gauge (a lot of people from different backgrounds ended up working on that project) my main task was to generalise the formulae by Ralph's and Pienaar's paper describing the expected loss of coherence from radially propagating modes to those following arbitrary geodesics and to implement the numerics. The actual challenge was not this generalisation itself (which turned out to be a differential geometry exercise), but rather understanding the general setting (a non-standard quantum optics model, as well as general relativity) just to be able to explicitly state the real problem.

Current state: In some part of the paper there seems to be a fatal flaw rendering the rest of it useless. We did not publish it in the end.