Göttingen Miniworkshop on
Theory and Applications of Non-Euclidean Statistics
Nov. 4 - 6, 2025

Venue: “Schlauch” at the Mathematisches Institut, Bunsenstraße 3-5, 37073 Göttingen

Tuesday, Nov. 4, 2025:

9:30 – 10:00	Registration & Refreshments	
10:00 – 11:30	**Phylogenetics Session I**	
10:00 – 10:30	Mahshid Mirhashemi	Computing Fréchet means via proximal splitting in nonlinear metric spaces
10:30 – 11:00	Sharanya Achut (online)	Brownian motion in phylogenetic tree spaces
11:00 – 11:30	Pauline Weigel	TBA
11:30 – 12:00	Refreshments	
12:00 – 13:00	**Phylogenetics Session II/NEST**	
12:00 – 12:30	Yuxi Liu	Clustering Phylogenetic Trees in BHV Space under Stickiness
12:30 – 13:00	Johan Köhne	A Concept of Bayesian Smeariness
13:00 – 15:00	Lunch (Refreshments and belegte Brötchen)	
15:00 – 16:00	Break (a few will be off for a zoom call)	
16:00 – 16:30	Refreshments	
16:30 – 17:30	**Fingerprint Session**	
16:30 – 17:00	Changxi Liu	Modeling Fingerprint Flow Structure Using an Intrinsic Coordinate Model
17:00 – 17:30	Constantin Totzke	Minutiae-based Growth Assessment in Fingerprints
18:30 –	Dinner Café Botanik (Persian food)	

Wednesday, Nov. 5, 2025:

9:00 – 10:30	**ENDOR Session I**	
9:00 – 10:00	Rajan Alexander	Hyperfine Tensors and Conformers: A Nonconformist Approach
10:00 – 10:30	Alina Tschirpke	Estimation of distance

		distributions from ENDOR spectra
10:30 – 11:00	Refreshments	
11:00 – 12:30	**ENDOR Session II & RNA**	
11:00 – 11:30	Kaisar Dauletbek (online)	TBA
11:30 – 12:00	Lukas Ungefug	Curved heteroscedastic drift models for ENDOR spectra
12:00 – 13:30	Lunch (Refreshments and belegte Brötchen)	
13:30 – 14:30	**Kolloquium** by Yvo Pokern	Estimation for a Riemannian Ornstein-Uhlenbeck Process on Covariance Matrices
14:30 – 15:00	Refreshments	
15:00 – 16:00	**ENDOR Session III**	
15:00 – 15:30	Marvin Lenjer	Mims Endor with microwave chirp pulses - Fourier transform EPR for structure determination
15:30 – 16:00	Sergei Kuzin	Mathematical aspects of multi-spin physics
17:00 – 18:00	Meeting with Marina Bennati (MPI Fassberg)	
18:30 –	Dinner Manzoni (Italian food)	

Thursday, Nov 6, hike in the Rhön (near Fulda)

Details will be fixed during the workshop. We plan to hike approx, 3 hours up to the Kreuzberg to have late **substantial Bavarian lunch** there and hike back down (approx 2 hours) and then unwind the day. Carpool to Fulda or come by train.

Abstracts

Computing Fréchet means via proximal splitting in nonlinear metric spaces (Mahshid Mirhashemi)

Computing Fréchet means in nonlinear metric spaces arises in applications such as symmetric positive definite matrices and phylogenetic tree spaces. We develop a convergence theory for proximal splitting algorithms based on almost firmly nonexpansive mappings in p-uniformly convex and CAT(k) spaces that removes the restrictive assumption of common fixed points, and it yields R-linear convergence with explicit rate bounds for a broad class of splitting algorithms.

Brownian Motion in phylogenetic tree spaces (Sharanya Achut)

The wald space is a recently introduced stratified space representing phylogenetic forests. In order to establish parametric statistical methods via diffusion processes, it is necessary to define a notion of Brownian motion within this space. In this talk, we introduce the structure and geometry of wald space, and discuss the challenges it poses for formulating Brownian motion. We review existing results on the convergence of random walks to Brownian motion in BHV space and on smooth manifolds, and discuss how these frameworks may inform approaching analogous convergence results in wald space.

Clustering Phylogenetic Trees in BHV Space under Stickiness (Yuxi Liu)

The Billera–Holmes–Vogtmann (BHV) tree space provides a geometric framework for analyzing phylogenetic trees by combining discrete topological and continuous branch-length variation within a nonpositively curved metric structure. In this space, Fréchet means offer a natural notion of average, but their computation and interpretation are complicated by the phenomenon of \ emph{stickiness}, where the mean can collapse onto lower-dimensional strata and become insensitive to small data perturbations.

Lammers, Nye, and Huckemann (2024) investigated this problem by analyzing directional derivatives of the Fréchet function in BHV space. They developed sufficient conditions for detecting which splits must appear in the mean tree and proposed algorithms that iteratively update topologies by minimizing directional derivatives. Building on the framework of Lammers, Nye, and Huckemann (2024), we will present a complementary and more pragmatic approach: an \ varepsilon-threshold clustering method that stabilizes mean-tree topology by pruning edges below a small length threshold and grouping trees based on their Fréchet distances. Applied to baboon gene-tree data, this hybrid framework reveals biologically meaningful clusters while alleviating computational instability caused by stickiness.

A Concept of Bayesian Smeariness (Johann Köhne)

Abstract: In statistical analysis on non-Euclidean data spaces it was recently found that for certain probability distributions the classical Central Limit Theorem for the Frechet mean does not hold. However, asymptotic properties can be recovered when we allow for slower convergence rates, a phenomenon that is called smeariness. The Bernstein-von-Mises (BvM) Theorem links Frequentist inference with Bayesian inference and we aim to investigate how smeariness affects Bayesian

inference and the BvM Theorem under model misspecification. In particular, crucial in the development of a BvM Theorem applicable to smeariness will be first to show that the posterior concentrates accordingly, which in turn depends on special covering numbers for missspecification. The talk is about work in progress.

Modeling Fingerprint Flow Structure Using an Intrinsic Coordinate Model (Changxi Liu)

This work builds upon the Intrinsic Coordinate System originally proposed by Christoph Handolt to model fingerprint flow structures using the theory of quadratic differentials. The developed parameterized model provides a geometric framework for representing ridge flows such as loops and aligning them with real fingerprint orientation data through an optimization pipeline. Results show that the model reproduces realistic fingerprint structures with lower angular errors than classical quadratic differential models, offering a promising geometrically grounded basis for fingerprint synthesis and analysis.

Minutiae-based Growth Assessment in Fingerprints (Constantin Totzke)

Fingerprints mainly grow isotropically, but is rescaling enough to capture growth effects regarding minutiae locations? In this talk we will discuss fingerprint basics, a model to estimate their growth and a selection of tests and metrics to analyse growth effects.

Estimation for a Riemannian Ornstein-Uhlenbeck Process on Covariance Matrices (Yvo Pokern)

A generalization of the Ornstein–Uhlenbeck process to the cone of covariance matrices endowed with the log-Euclidean and the affine-invariant metrics is presented. The development exploits the Riemannian structure of symmetric positive definite matrices viewed as a smooth manifold. Bayesian inference for discretely observed diffusion processes of covariance matrices is then carried out based on an MCMC algorithm. Our proposed algorithm is illustrated with a real data financial application.

This is joint work with Prof. Petros Dellaportas (UCL) and Dr Bui Ngoc Mai (British University Vietnam)