Johannes Wieditz

List of publications

Journal publications

Characteristic and Necessary Minutiae in Fingerprints

Johannes Wieditz, Yvo Pokern, Dominic Schuhmacher, Stephan Huckemann
Journal of the Royal Statistical Society: Series C (Applied Statistics), 2022, Volume 71, Issue 1, pp 27–50.
`https://rss.onlinelibrary.wiley.com/doi/10.1111/rssc.12520`

Abstract: Fingerprints feature a ridge pattern with moderately varying ridge frequency (RF), following an orientation field (OF), which usually features some singularities. Additionally at some points, called minutiae, ridge lines end or fork and this point pattern is usually used for fingerprint identification and authentication. Whenever the OF features divergent ridge lines (e.g. near singularities), a nearly constant RF necessitates the generation of more ridge lines, originating at minutiae. We call these the necessary minutiae. It turns out that fingerprints feature additional minutiae which occur at rather arbitrary locations. We call these the random minutiae or, since they may convey fingerprint individuality beyond the OF, the characteristic minutiae. In consequence, the minutiae point pattern is assumed to be a realization of the superposition of two stochastic point processes: a Strauss point process (whose activity function is given by the divergence field) with an additional hard core, and a homogeneous Poisson point process, modelling the necessary and the characteristic minutiae, respectively. We perform Bayesian inference using an MCMC-based minutiae separating algorithm (MiSeal). In simulations, it provides good mixing and good estimation of underlying parameters. In application to fingerprints, we can separate the two minutiae patterns and verify by example of two different prints with similar OF that characteristic minutiae convey fingerprint individuality.

An algorithm for computing Fréchet means on the sphere

Gabriele Eichfelder, Thomas Hotz, **Johannes Wieditz**
Optimization Letters, 2019, Volume 13, Issue 7, pp 1523–1533.
`https://link.springer.com/article/10.1007/s11590-019-01415-y`

Abstract: For most optimisation methods an essential assumption is the vector space structure of the feasible set. This condition is not fulfilled if we consider optimisation problems over the sphere. We present an algorithm for solving a special global problem over the sphere, namely the determination of Fréchet means, which are points minimising the mean distance to a given set of points. The Branch and Bound method derived needs no further assumptions on the input data, but is able to cope with this objective function which is neither convex nor differentiable. The algorithm's performance is tested on simulated and real data.

Non-Asymptotic Confidence Sets for Circular Means

Thomas Hotz, Florian Kelma, **Johannes Wieditz**
Entropy, 2016, 18.10, 375.
`https://www.mdpi.com/1099-4300/18/10/375`

Abstract: The mean of data on the unit circle is defined as the minimizer of the average squared Euclidean distance to the data. Based on Hoeffding's mass concentration inequalities, non-asymptotic confidence sets for circular means are constructed which are universal in the sense that they require no distributional assumptions. These are then compared with asymptotic confidence sets in simulations and for a real data set.

Reviewed conference proceedings

Universal, non-asymptotic confidence sets for circular means

Thomas Hotz, Florian Kelma, **Johannes Wieditz**
Lecture Notes in Computer Science, 2015, Volume 9389.

Abstract: Based on Hoeffding's mass concentration inequalities, non-asymptotic confidence sets for circular means are constructed which are universal in the sense that they require no distributional assumptions. These are then compared with asymptotic confidence sets in simulations and for a real data set.

Clinical studies and trials

Blood Culture Headspace Gas Analysis Enables Early Detection of Escherichia coli Bacteremia in an Animal Model of Sepsis

Maximilian Euler, Thorsten Perl, Isabell Eickel, Anna Dudakova, Esther Maguilla Rosado, Carolin Drees, Wolfgang Vautz, **Johannes Wieditz**, Konrad Meissner, Nils Kunze-Szikszay
Antibiotics, 2022, 11.8, 992.
`https://www.mdpi.com/2079-6382/11/8/992`

Abstract:

- Background: Automated blood culture headspace analysis for the detection of volatile organic compounds of microbial origin (mVOC) could be a non-invasive method for bedside rapid pathogen identification. We investigated whether analyzing the gaseous headspace of blood culture (BC) bottles through gas chromatography-ion mobility spectrometry (GC-IMS) enables differentiation of infected and non-infected.
- Methods: BC were gained out of a rabbit model, with sepsis induced by intravenous administration of E. coli (EC group; $n = 6$) and control group ($n = 6$) receiving sterile LB medium intravenously. After 10 h, a pair of blood cultures was obtained and incubated for 36 h. The headspace from aerobic and anaerobic BC was sampled every two hours using an autosampler and analyzed using a GC-IMS device. MALDI-TOF MS was performed to confirm or exclude microbial growth in BCs.

- Results: Signal intensities (SI) of 113 mVOC peak regions were statistically analyzed. In 24 regions, the SI trends differed between the groups and were considered to be useful for differentiation. The principal component analysis showed differentiation between EC and control group after 6 h, with 62.2% of the data variance described by the principal components 1 and 2. Single peak regions, for example peak region P_{15}, show significant SI differences after 6 h in the anaerobic environment ($p < 0.001$) and after 8 h in the aerobic environment ($p < 0.001$).
- The results are promising and warrant further evaluation in studies with an extended microbial panel and indications concerning its transferability to human samples.