Technische Universität Dresden

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Sommersemester 2026

Dresdner Mathematisches Seminar

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Heavy tails in stochastic optimization: emergence and implications

Heavy-tailed distributions, known for producing observations that can be extremely large and distant from the mean, are often associated in machine learning and statistics with negative consequences such as outliers and numerical instability. Despite their daunting reputation, heavy-tailed behaviors are ubiquitous across many natural systems. The goal of this talk is to argue that heavy tails should not be conceived as 'surprising' or 'anomalous' phenomena; on the contrary, they may offer benefits for machine learning algorithms. This work brings together investigations conducted by my colleagues, students, postdocs, and myself on the emergence and implications of heavy-tailed phenomena in stochastic optimization, particularly in the context of deep learning and stochastic gradient descent (SGD). We first demonstrate that heavy tails can naturally arise in SGD, even when the underlying data is not heavy-tailed, highlighting the influence of algorithmic hyperparameters and multiplicative noise structures. Using continuous-time proxy models based on Lévy-driven stochastic differential equations, we develop generalization bounds that explicitly link heavy-tailed behavior to improved test performance. Further, we explore how heavy tails can create compressibility in neural network parameters and examine their potential in a differential privacy context. Our findings offer a nuanced perspective: while heavy tails can indeed be beneficial up to a certain point, 'excessive heavy' tails may eventually degrade optimization and generalization.
Manuscript link: https://hal.science/tel-05434401/

Mittwoch, 10.06.2026, 17:00 Uhr – Willers-Bau, Raum A 124

Leitung: Prof. Dr. Anita Behme

Vor dem Vortrag findet **ab 16:30 Uhr** ein gemeinsames **Kaffee-/ Teetrinken** vor dem Vortragsraum WIL A 124 statt.

Stand: 01.06.2026

Bereich Mathematik und Naturwissenschaften
Fakultät Mathematik