

A U S H A N G

FREIE UNIVERSITÄT BERLIN

Fachbereich Mathematik und Informatik

Promotionsbüro, Arnimallee 14, 14195 Berlin

D I S P U T A T I O N

Freitag, 30. Januar 2026, 12:30 Uhr

Ort: Seminarraum 006

(Fachbereich Mathematik und Informatik, Takustr. 9, 14195 Berlin)

Disputation über die Doktorarbeit von

Ziyue Tang

Thema der Dissertation:

Blockchain and AI-Driven Security and Performance in Train Control Systems

Thema der Disputation:

The Evolution of Train Control System

Die Arbeit wurde unter der Betreuung von **Prof. Dr. K. Wolter** durchgeführt.

Abstract: Part I: The Evolution of Train Control System This part provides an overview of the history of railway control system, tracing the technological shift from mechanical, manual operations to digitalized control systems. While modern signaling has significantly increased efficiency, it relies heavily on centralized control centers.

This centralization introduces the single point of failure. We will discuss the real-world risks associated with this architecture, such as system-wide failure due to communication loss or malicious attacks. In addition, we will review historical system failures to highlight the problems of the current centralized model. This part highlights the need for a new approach: replacing the current centralized model with a decentralized system to improve security and performance.

Part II: Blockchain and AI-Driven Security and Performance in Train Control System This part outlines the technical realization of the proposed framework, focusing on scalability, reliability, and intelligence. It introduces a decentralized, blockchain-based mechanism to distribute movement authority, addressing scalability while maintaining performance. To ensure data integrity, it presents an adaptive verification and reputation model to filter faulty or malicious inputs. The discussion then shifts to system intelligence, illustrating how trains can evolve into autonomous agents through collaborative learning while preserving data privacy. Finally, this part extends the framework to network-level optimization, proposing dynamic resource allocation to improve overall railway efficiency.

Die Disputation besteht aus dem o. g. Vortrag, danach der Vorstellung der Dissertation einschließlich jeweils anschließenden Aussprachen.

Interessierte werden hiermit herzlich eingeladen

Die Vorsitzende der Promotionskommission
Prof. Dr. K. Wolter