UNIKASSEL VERSITÄT

mrt
Mess- und Regelungstechnik
Univ.-Prof. Dr.-Ing. Andreas Kroll

Seminar-, Semester-, Projekt- oder Bachelorarbeit (auf Deutsch oder Englisch)

Modeling Power Consumption Signals of Mixers in Ultra-High Performance Concrete Production Process

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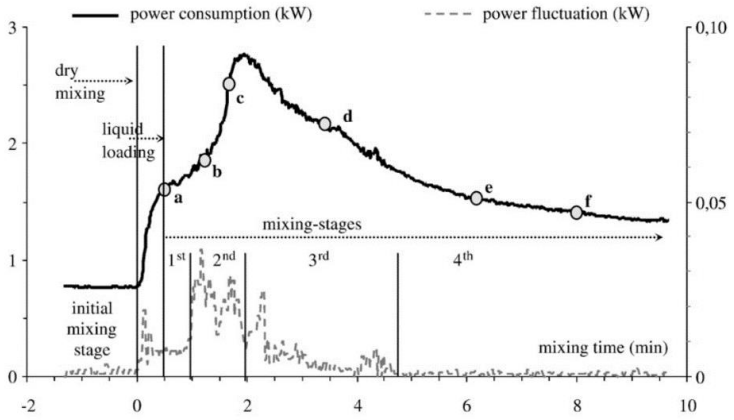
The power consumption signal generated by a concrete mixer during the mixing process offers valuable insights into the mechanical energy required to mix concrete components. Variations in this signal are influenced by factors such as the humidity of raw materials (e.g., type and volume of aggregates and cement) and the evolving properties of fresh concrete (e.g., workability). In the production of Ultra-High Performance Concrete (UHPC), which utilizes minimal water volume, even small fluctuations in the moisture content of raw materials can significantly impact the mixture's workability and the final mechanical properties. Thus, modeling the power consumption signal could be crucial for predicting the humidity of raw materials and key characteristics of fresh concrete, and can potentially provide critical information regarding the final mechanical properties of UHPC. This approach can enhance quality control, minimize the need for manual testing, and optimize the mixing process.



Within the EEpBeton-Project, a series of 100 experiments have been designed and conducted, with the power consumption signal of each mixing process being recorded. The objective of this study is to develop a comprehensive understanding of the power consumption signals available from the concrete mixer and to create predictive models using computational and machine learning techniques. These models will focus specifically on predicting the humidity of the raw materials, the characteristics of the fresh UHPC, and the final mechanical properties of the UHPC based on the power consumption signals.

Tasks and Responsibilities:

1. Conduct a comprehensive review of existing research on power consumption signals during the concrete mixing process, focusing on how these signals can be modeled and utilized for predicting material and final product properties.
2. Analyze the experimental data from the EEpBeton-Project to identify key features in the power consumption signals that correlate with changes in raw material moisture, fresh concrete properties (e.g., peaks, stabilization phases), and final mechanical properties.
3. Development of Predictive Models:
    - Utilize computational modeling techniques to simulate power consumption signals under different mixing scenarios and varying raw material properties.
    - Apply machine learning algorithms (e.g., regression models, neural networks) to develop predictive models capable of estimating raw material humidity, fresh concrete characteristics, and the final mechanical properties of UHPC from power consumption signals.
    - Train and validate these models using the available experimental data to ensure their robustness, accuracy, and reliability.
4. Documentation and Presentation of Findings.

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Start: …
End: …

References:

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[2] Cazacliu, B. (2008). In-mixer measurements for describing mixture evolution during concrete mixing. chemical engineering research and design, 86(12), 1423-1433.

[3] Rezazadeh, F., & Kroll, A. (2022). Predicting the Compressive Strength of Concrete up to 28 Days-Ahead: Comparison of 16 Machine Learning Algorithms on Benchmark Datasets. Proceedings - 32. Workshop Computational Intelligence: Berlin, 1. - 2. Dezember 2022. https://doi.org/10.58895/ksp/1000151141-4

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