INSTITUT FÜR RISIKO UND ZUVERLÄSSIGKEIT

Leibniz Universität Hannover

# Calculation of Accelerograms for Scaled-Down Shaking Tables in Earthquake Engineering

*Berechnung von Accelerogrammen für skalierte Erdbeben Simulationstische*

**Aufgabenstellung, Projektarbeit oder Bachelorarbeit**

**Vorraussetzungen:**
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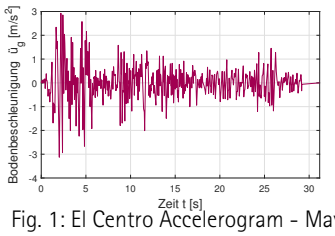

Fig. 1: El Centro Accelerogram - May 18, 1940 - North-South Component.

Accelerograms are essential tools in earthquake engineering to analyze the behavior of structures under seismic loading. This research task focuses on generating accelerograms specifically for scaled-down shaking tables, which are used in experiments to study the earthquake response of structures at a smaller scale. Creating smaller models for experiments is often necessary for practical and financial reasons, as building full-scale prototypes can be costly and logistically challenging.
This work will include a literature review on accelerograms and their significance in earthquake engineering. This will encompass an analysis of why accelerograms need to be scaled for experiments at a smaller scale. Special emphasis will be placed on the challenges and methodological approaches to generating scaled accelerograms.
Additionally, the research will explore the relevance of experiments at a smaller scale for earthquake simulations and civil engineering. This will involve discussing how such experiments can contribute to improving the understanding of structural behavior under earthquake loading and what insights from these experiments can be transferred to real structures.
Finally, experiments on a scaled shaking table will be conducted (virtually or physically), and the results will be compared with theoretical predictions and insights from the literature review. Aspects such as scale effects and the transferability of results will be a primary focus.

## Objectives

- Comprehensive literature review on accelerograms in earthquake engineering, including their significance and applications.
- Investigation of the reasons and methods for scaling down accelerograms for experiments at a smaller scale.
- Analysis and assessment of the relevance of scaled-down shaking table experiments for earthquake simulation and civil engineering.
- Development and implementation of methods for generating scaled accelerograms while considering scale effects.
- Conducting experiments on scaled shaking tables and comparing the results with theoretical predictions and insights from the literature.
- Discussion of the transferability of results to full-scale structures and evaluation of the utility of such experiments for earthquake engineering.

## Bibliographie (Auswahl)

[1] *Li*, J. and *Chen*, J. (2010). Stochastic Dynamics of Structures, *John Wiley & Sons*.
[2] *Chopra*, A.K. (1996). Dynamics of Structures: Theory and Applications to Earthquake Engineering, *Prentice Hall*.
[3] *Priestley*, M., *Calvi*, G., *Kowalsky*, M., *Powell*, G. (2008). Displacement-Based Seismic Design of Structures, *Earthquake Spectra* 24. 10.1193/1.2932170.
[4] *Damcı*, E., *Şekerci*, C. (2019) Development of a Low-Cost Single-Axis Shake Table Based on Arduino, *Experimental Techniques* 43, 179–198
[5] *Levis*, M. (2018). Scaling Earthquakes - the Quanser Way, *Earthquake Engineering Blog*, https://www.quanser.com/blog/scaling-earthquakes-quanser-way/. Accessed: Sep. 2023

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