# Prediction and Control of Rolling Noise in Buildings
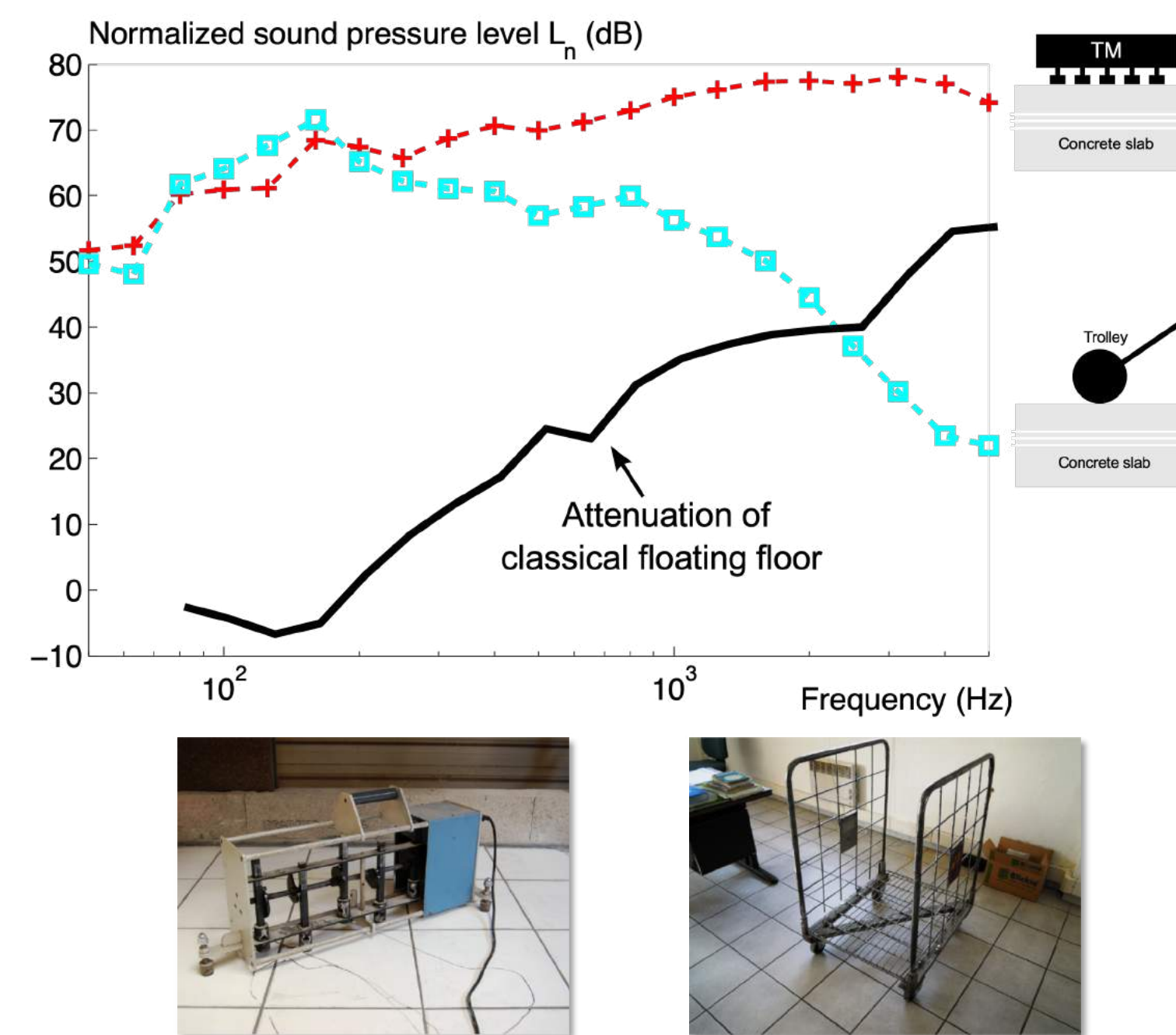
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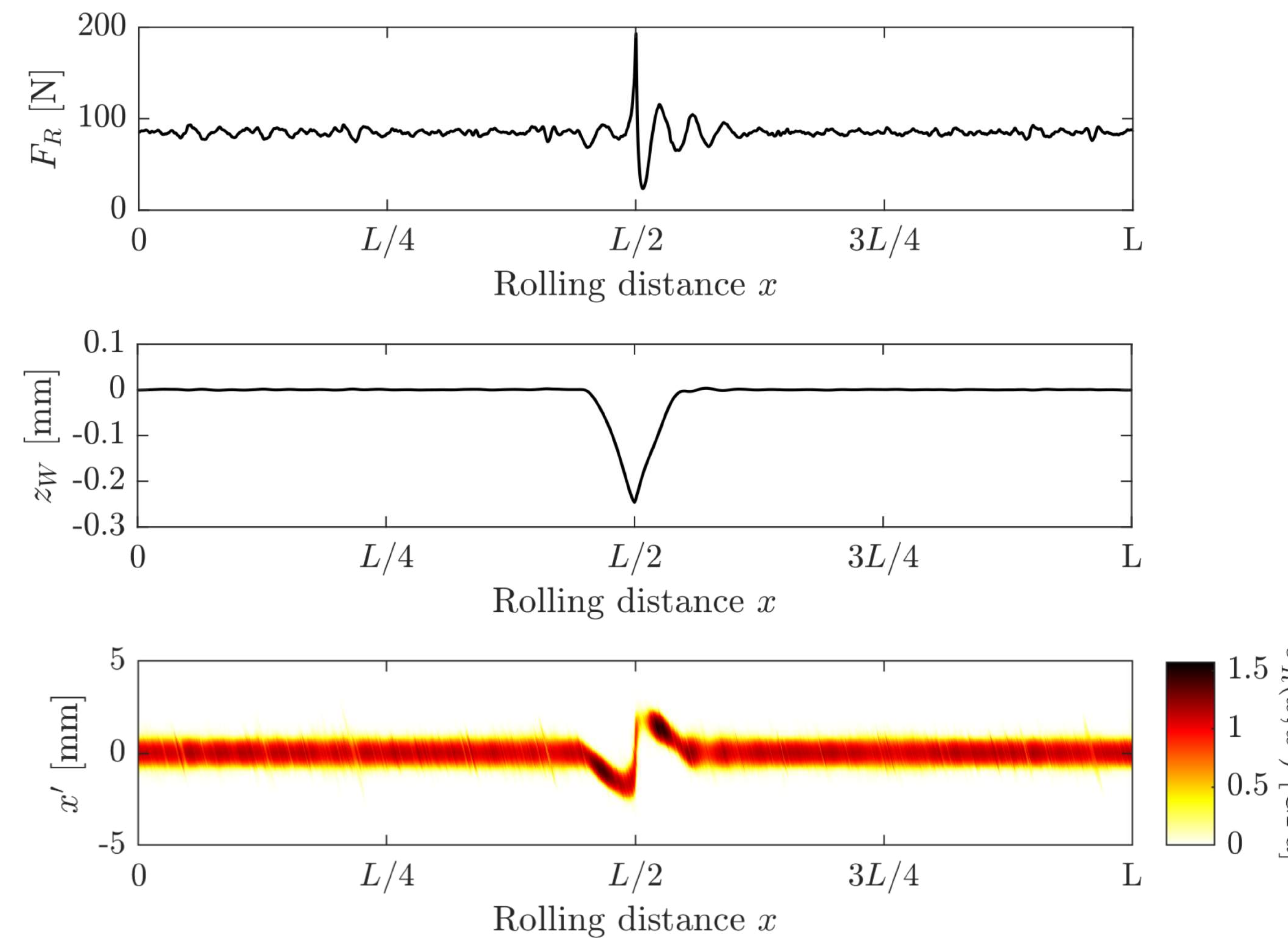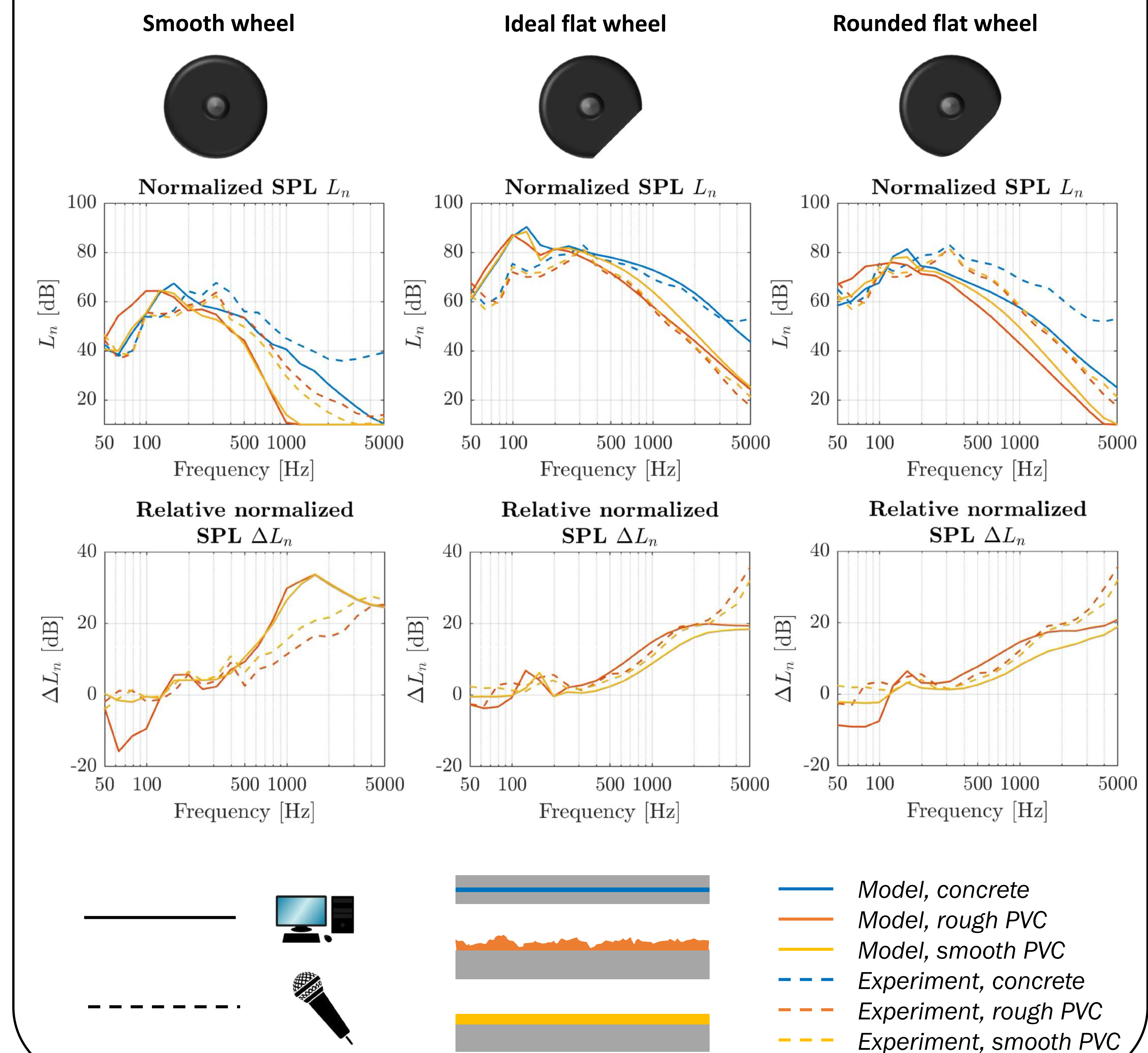## Matelys Research Lab | Lyon, France

## Introduction

- Impact noise is the primary structure-borne noise source regulated in buildings today, using a tapping machine.
- Research is beginning to take place for other structure-borne sources, such as rolling noise.
- Novel modeling techniques must be developed to predict the sound propagation of rolling noise in buildings.
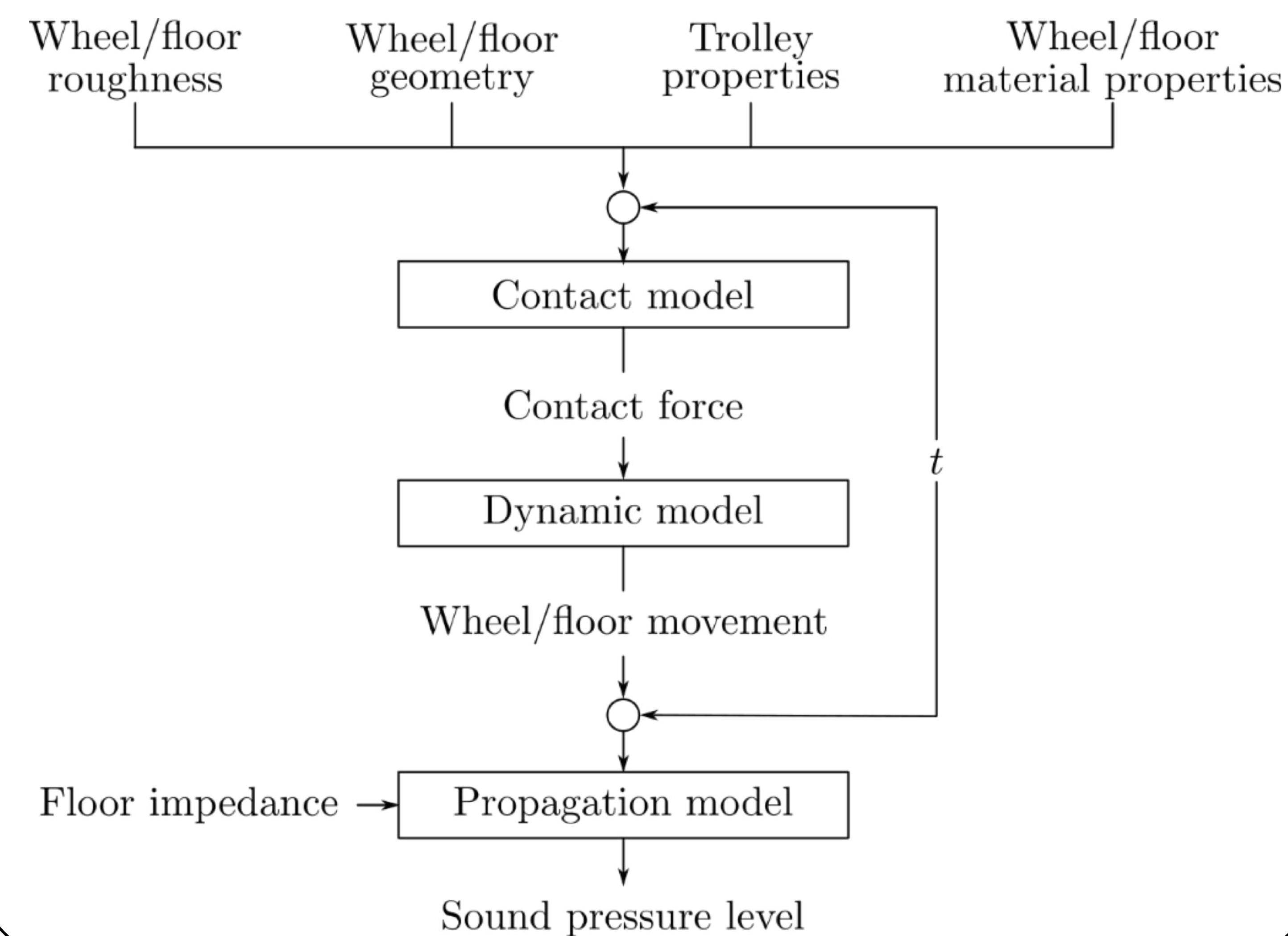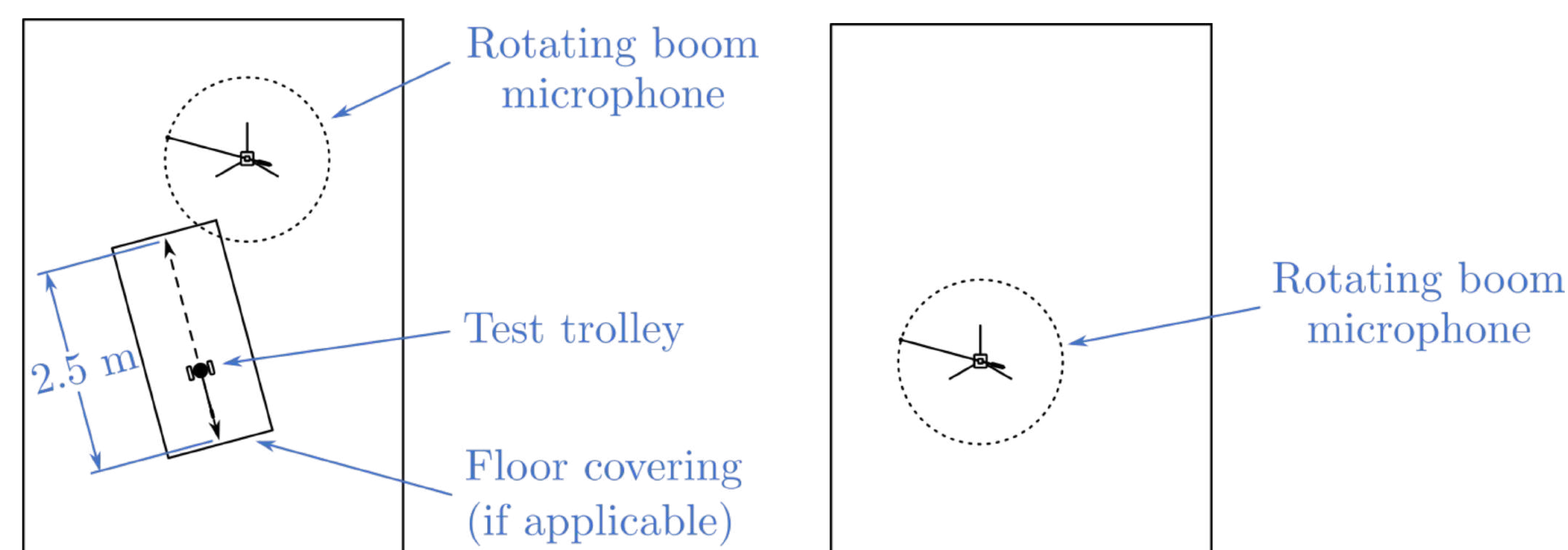


## Objective

Develop a numerical model that can...

- Accurately represent the physical phenomena present in indoor rolling contact
- Estimate the relative benefit provided by a floor covering at reducing indoor rolling noise

## Rolling Model



Wheel/floor roughness | Wheel/floor geometry | Trolley properties | Wheel/floor material properties

Contact model
Contact force
Dynamic model
Wheel/floor movement
Floor impedance → Propagation model
Sound pressure level

## Contact force and wheel response: Rounded flat wheel



## Experimental testing



Two-wheel test trolley

Emission room at the industrial partner in France

Emission room at Level Acoustics & Vibration



Rotating boom microphone

2.5 m

Test trolley

Floor covering (if applicable)

Rotating boom microphone

## Model vs experimental results



Smooth wheel | Ideal flat wheel | Rounded flat wheel

Normalized SPL $L_n$

Relative normalized SPL $\Delta L_n$

- Model, concrete
- Model, rough PVC
- Model, smooth PVC
- Experiment, concrete
- Experiment, rough PVC
- Experiment, smooth PVC

## Conclusions and future work

- The developed model estimates the normalized sound pressure level of an indoor rolling trolley, capturing the physical phenomena unique to indoor rolling noise.
- Support for multi-layer floors and discrete irregularities such as wheel flats and floor joints.
- The model has been validated with experimental results from two laboratories.
- May be used to identify ideal floor materials and multi-floor systems for reducing rolling noise.
- The development of a standard rolling device would benefit the advancement of indoor rolling noise research.
- Future work may include upward and lateral transfer paths.