



3rd ICTG 2016

04-07 September 2016, Guimarães, Portugal



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Testing Soil Compaction – High-speed Measurements of scaled Compactors

Holger Pankrath, Rosa Elena Ocaña Atencio,
Alexander Knut, Ralf Thiele

Leipzig University of Applied Sciences, G² Group Geotechnics, Germany



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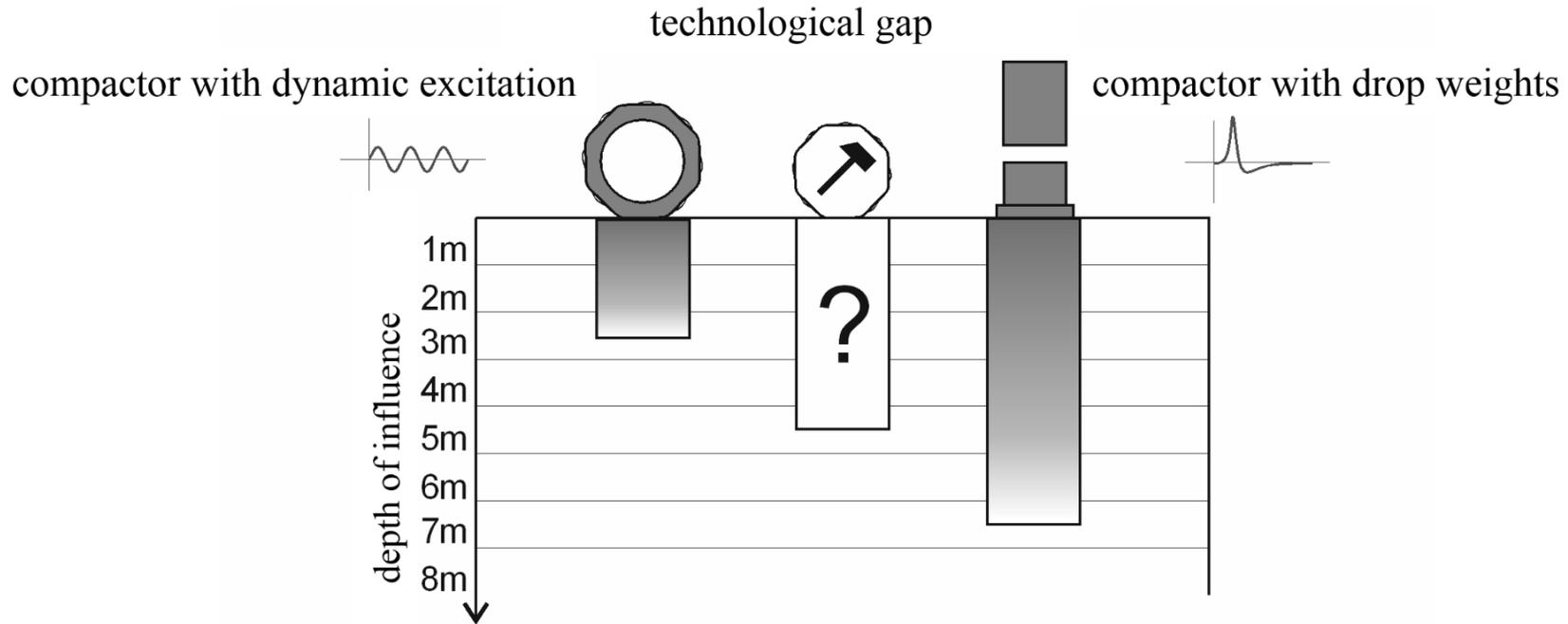
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Motivation



*Procedia Engineering, Volume 125, 2015,
Pages 390-396, ISSN 1877-7058*

Motivation

Setup/Processes

Test Series

Conclusion



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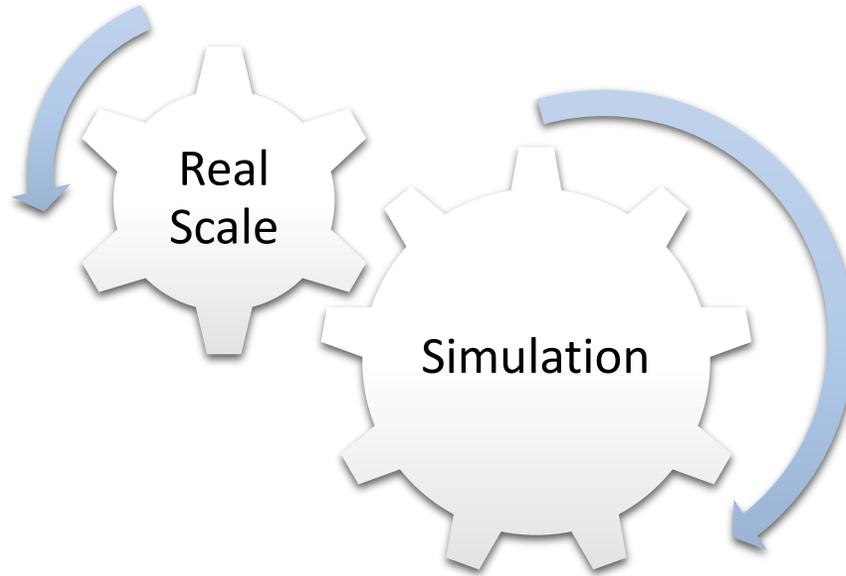


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Field tests with
cone penetration tests, layer by layer excavation, ...



Abaqus Explicit, reducing of element distortion by
ALE adaptive meshing and CEL

Modified Drucker-Prager Cap Model

Procedia Engineering, Volume 125, 2015,
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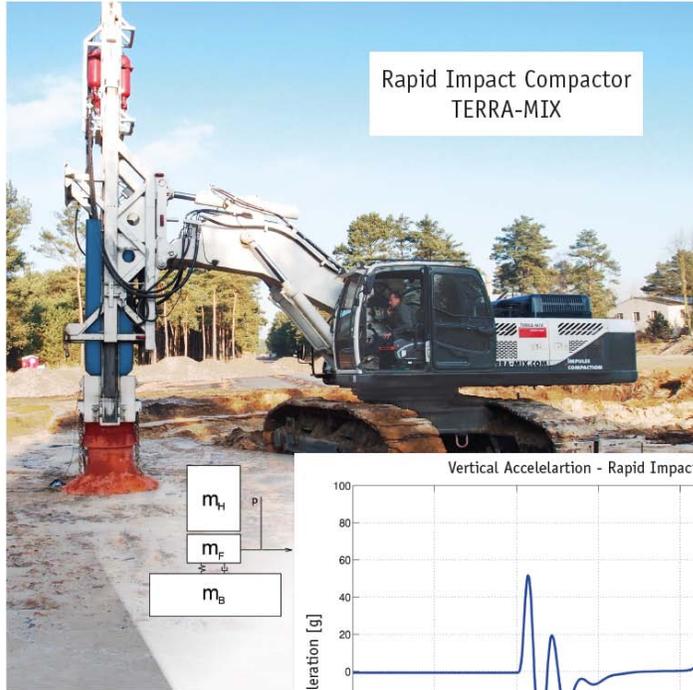
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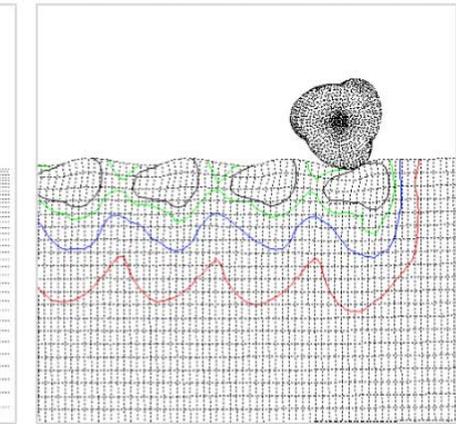
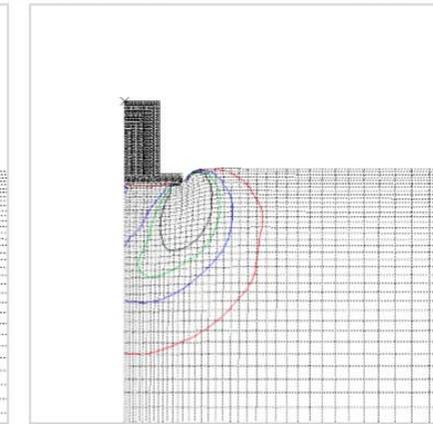
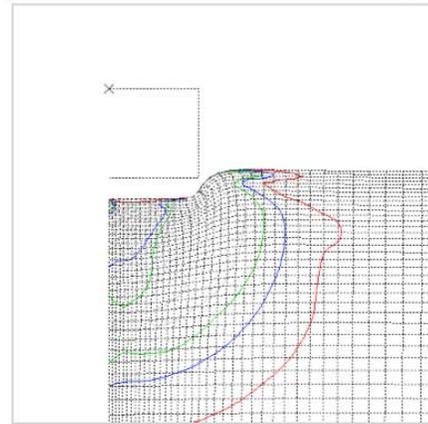
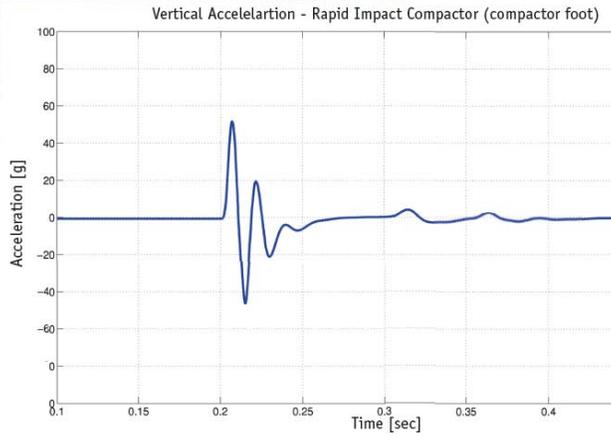
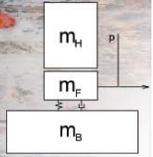
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Rapid Impact Compactor
TERRA-MIX



*Procedia Engineering, Volume 125, 2015,
Pages 390-396, ISSN 1877-7058*

Motivation → Setup/Processes → Test Series → Conclusion



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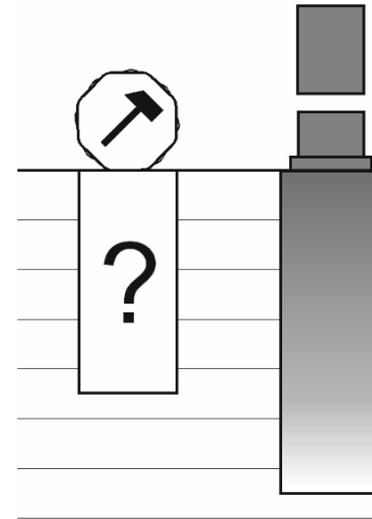
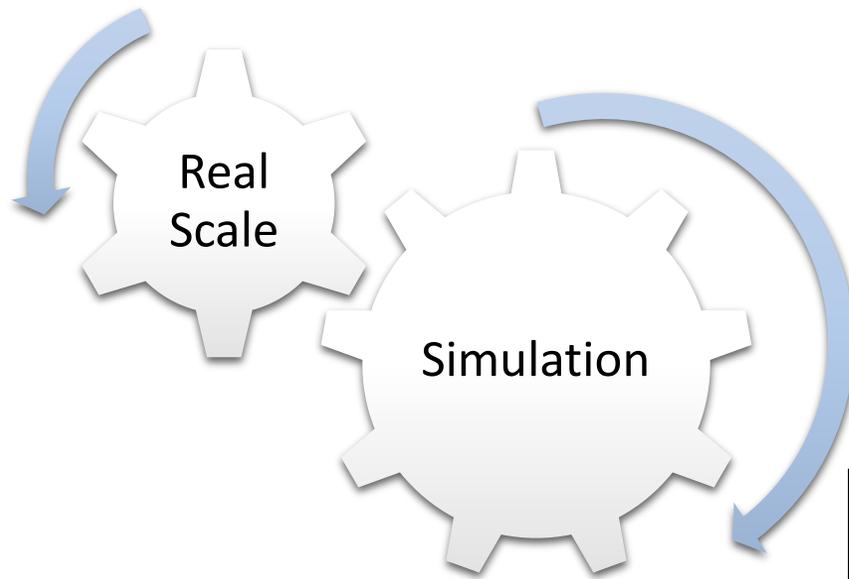
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Soil behavior
 - during compaction
 - below compactor



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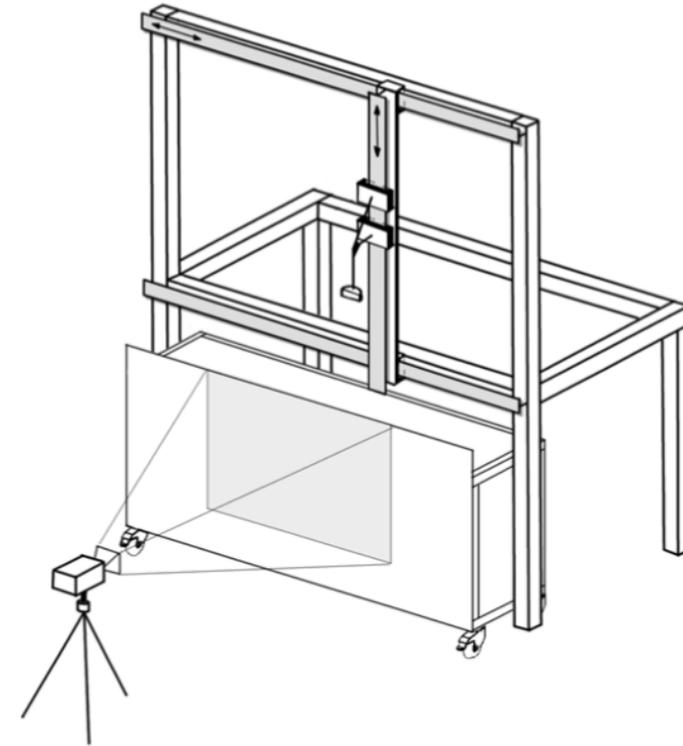
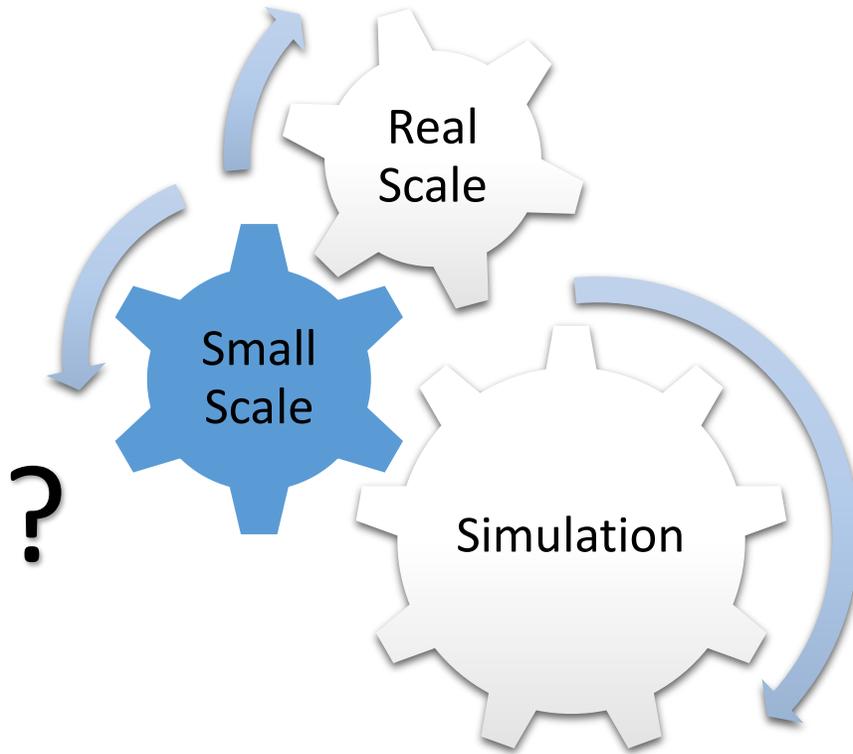
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- Optical and Physical Measurements
- High Speed Imaging
 - DIC/PIV (Digital Image Correlation)
 - Acceleration Sensors

Motivation

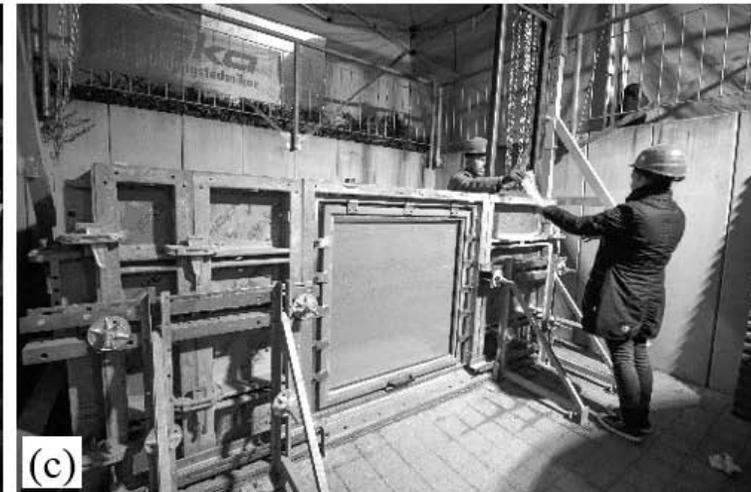
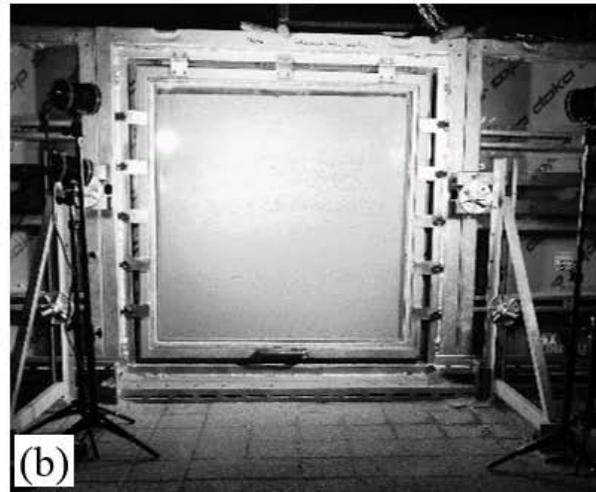
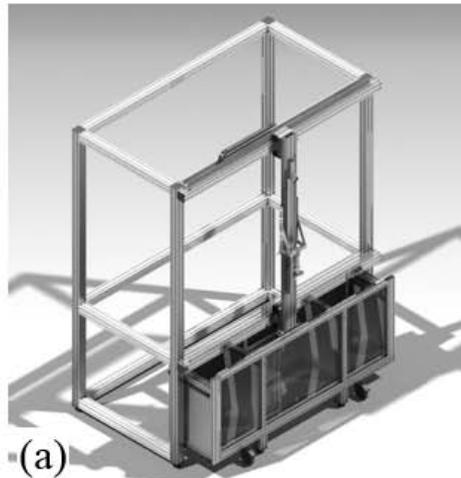
Setup/Processes

Test Series

Conclusion



Experimental Setup and Processes



Test setups with transparent section plane for optical measurements with the DIC/PIV method
(a) test station S (small) for a volume of test soil up to 0.4m^3 and
(b, c) test station M (medium) for volume of test soil up to 5 m^3 , laying on natural soil

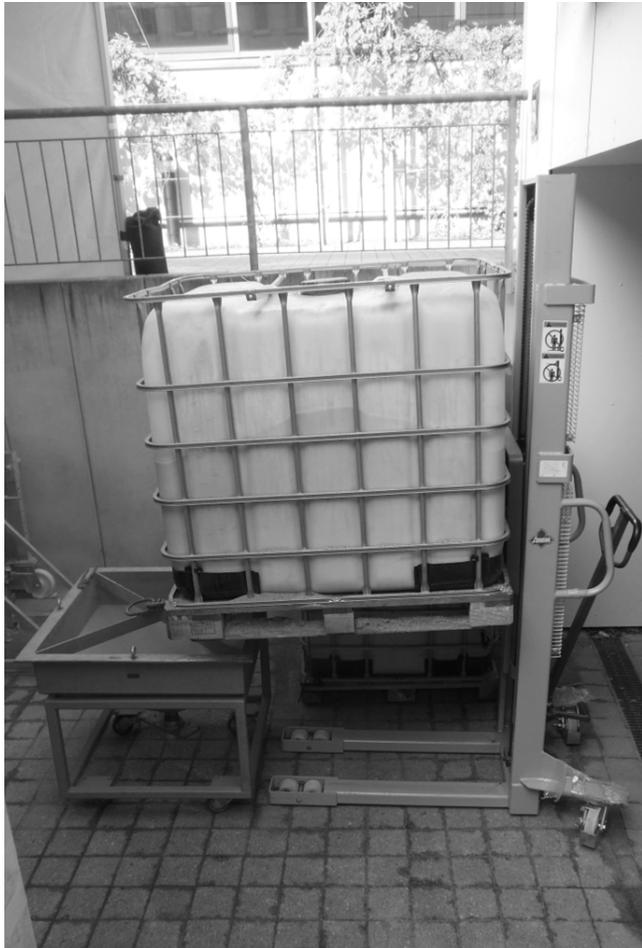


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Motivation

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Test Station M



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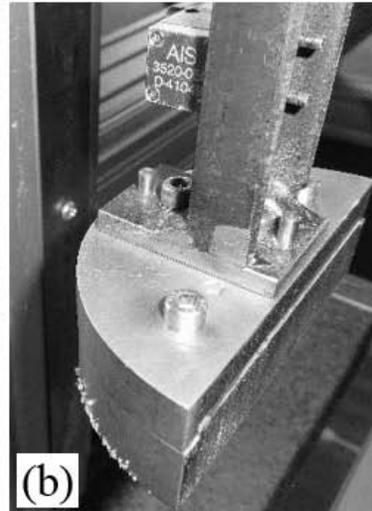
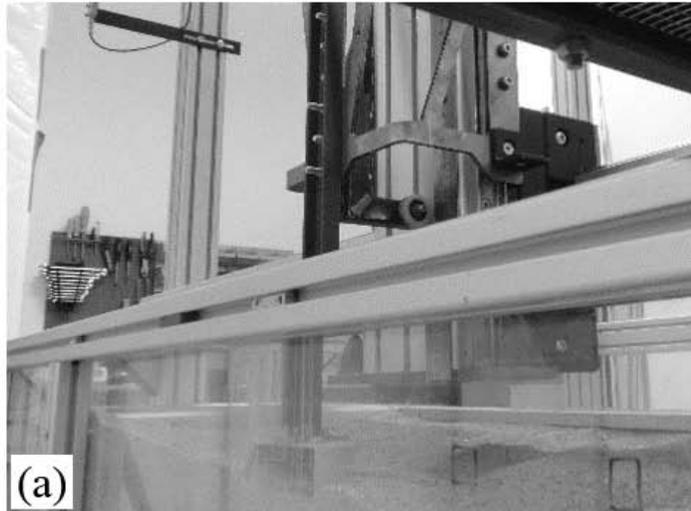
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Guided freefall weights with variable basic shapes and falling heights up to 1.2m

(a, b) test station S with weights between 4.5kg and 6.75kg

(c, d) test station M with weights between 26kg and 70kg

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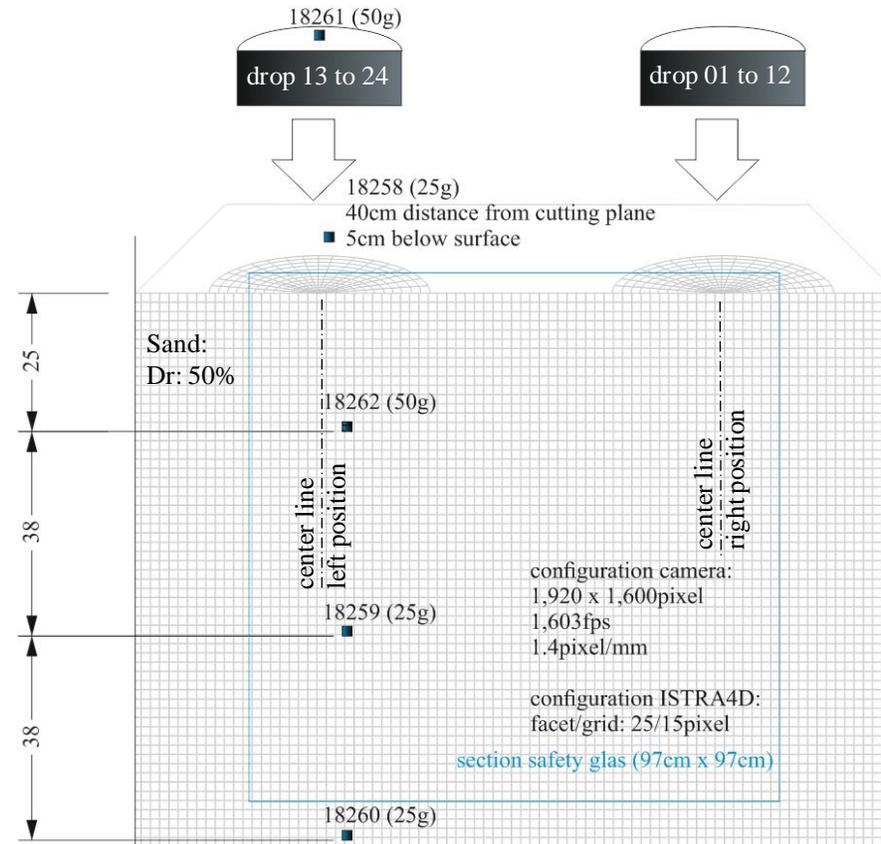
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Test station M, configuration for 12 drops on each side with a falling height of 0.34m, a falling weight 47kg and a diameter of 0.3m

Motivation

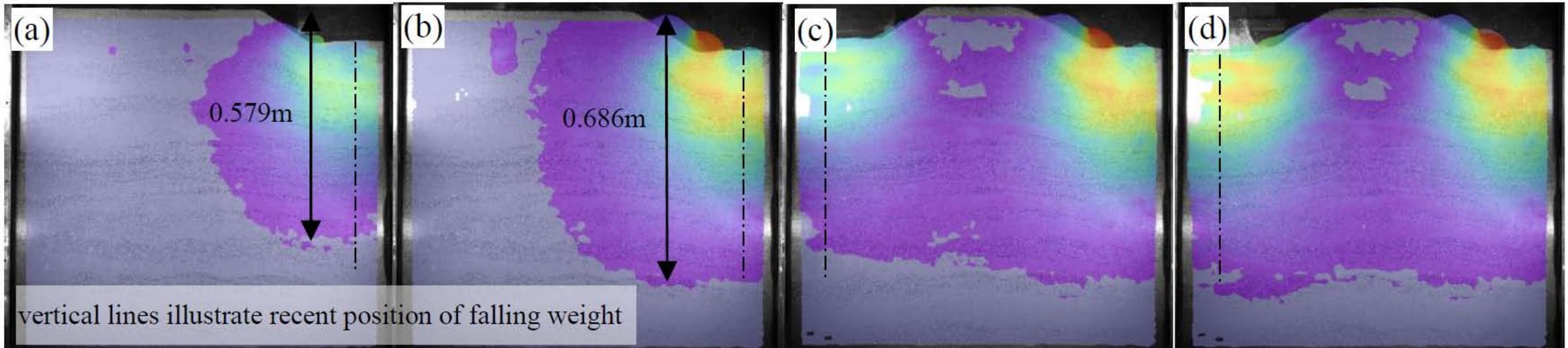
Setup/Processes

Test Series

Conclusion



Test Series with scaled Falling Weights



Test station M, evaluation of 12 + 12 drops, total displacements > 10mm,

(a) drop No. 6 right position, (b) drop No. 12 right position, (c) drop No. 6 left position, (d) drop No. 12 left position, compared to situation before compaction

Motivation

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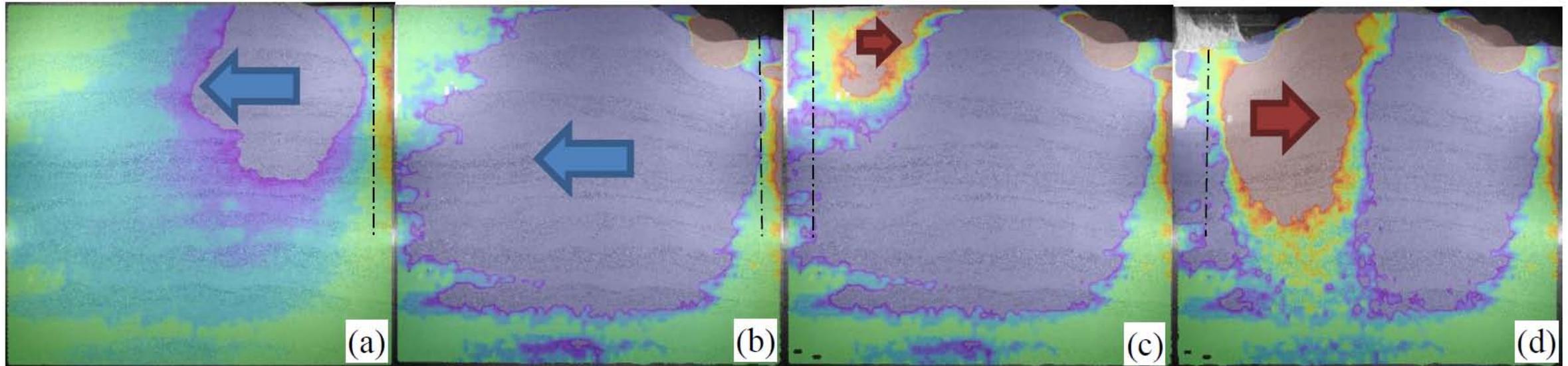
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Test station M, evaluation of 12 + 12 drops, horizontal displacements (x) between +/- 2mm,
 (a) drop No. 1 right position, (b) drop No. 12 right position, (c) drop No. 1 left position,
 (d) drop No. 12 left position, compared to situation before compaction

Motivation

Setup/Processes

Test Series

Conclusion

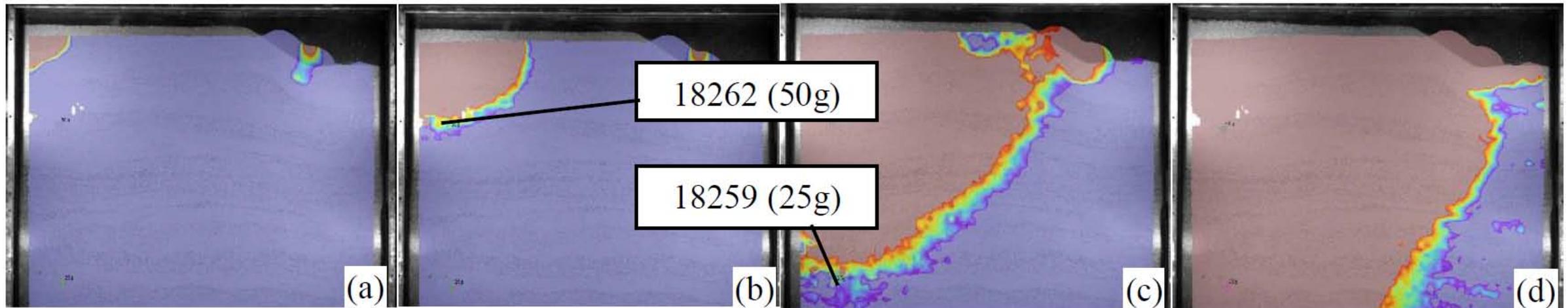


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Test station M, evaluation of 1 drop at left position, total displacements between 0.1mm and 0.2mm at, (a) 0.0019sec, (b) 0.0044sec, (c) 0.0094sec and, (d) 0.018sec after impact, with marking the positions of 2 acceleration sensors in the sand

Motivation

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Test Series

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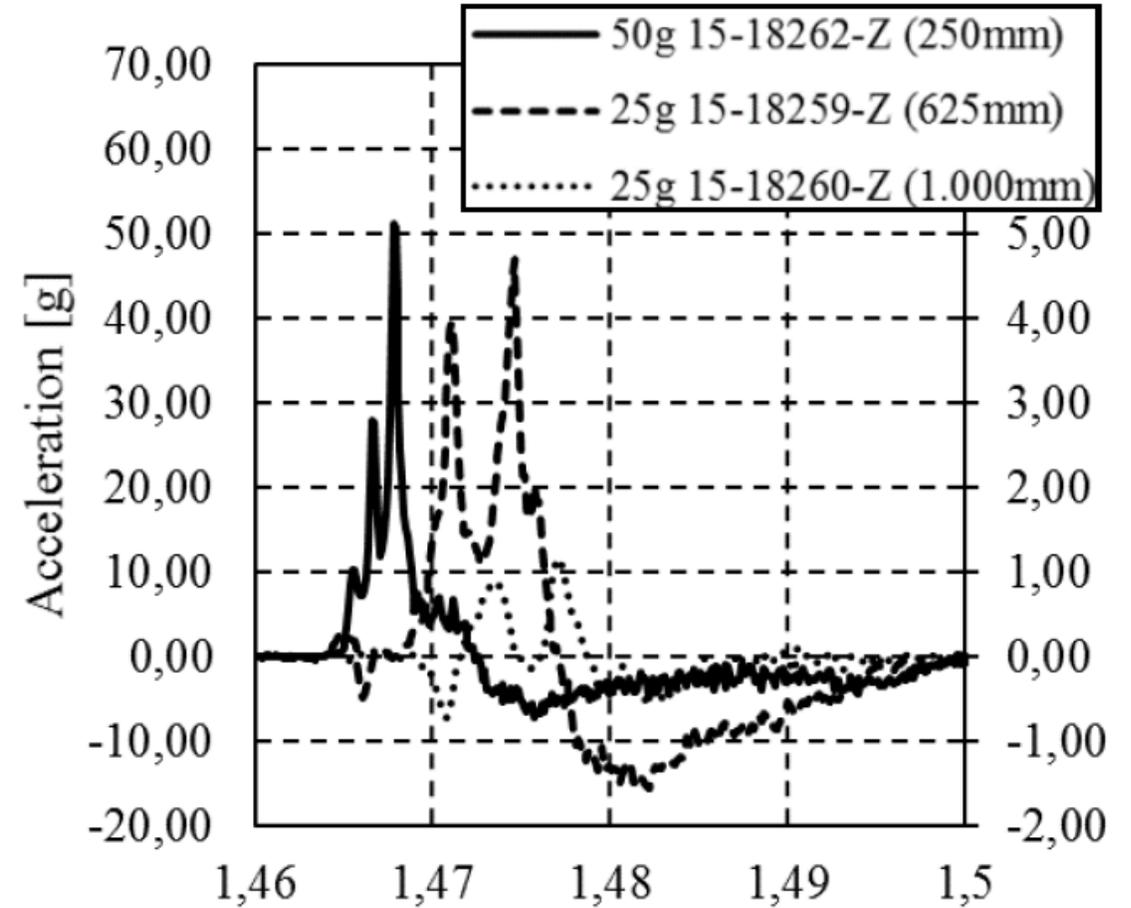
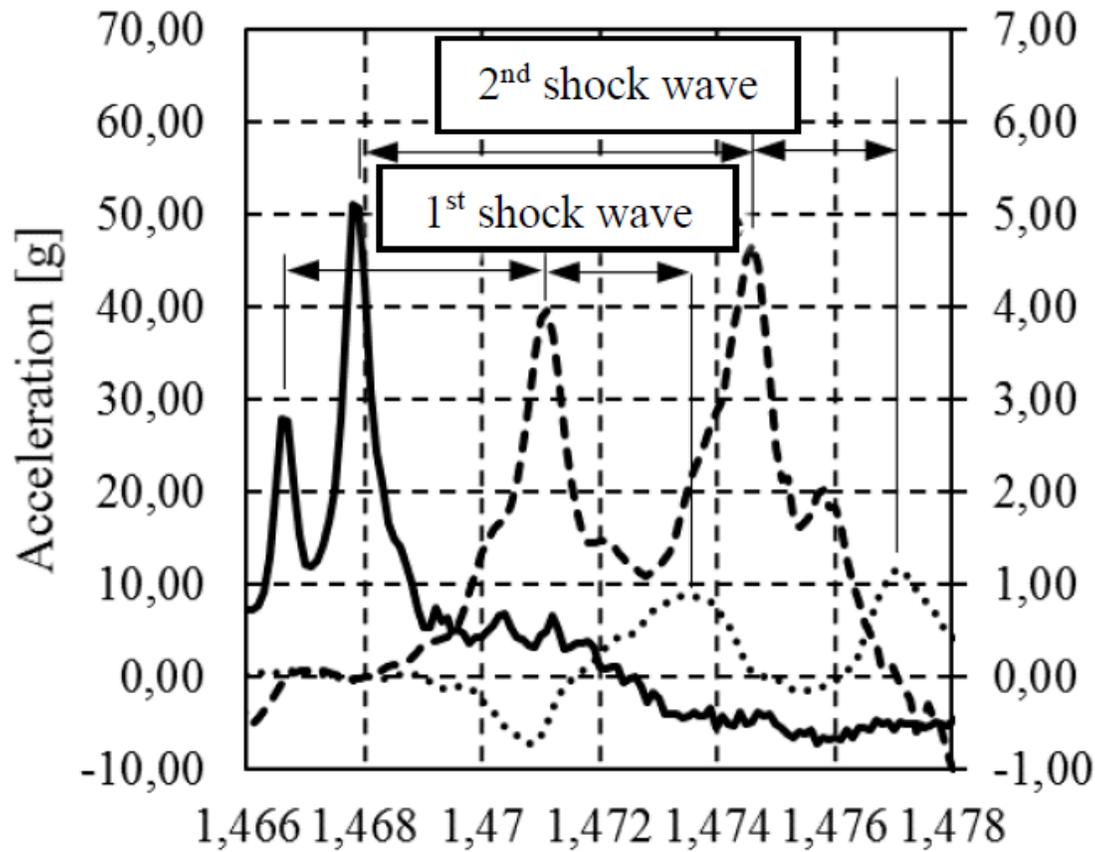


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Vertical acceleration in soil, 250mm, 625mm und 1.000mm below surface, medium dense sand (Dr: 50%)

Motivation

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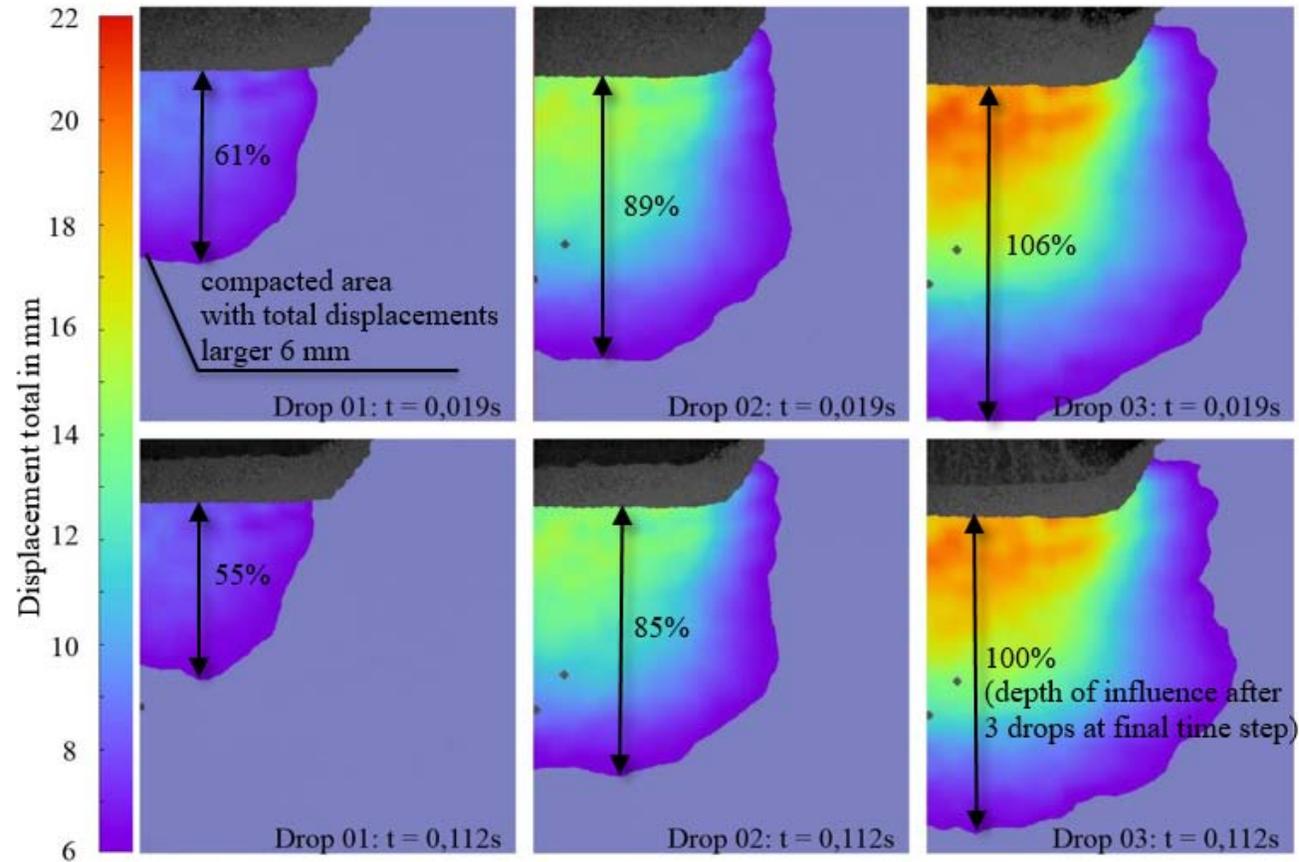
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Test station M, evaluation of 3 drops, total displacements > 20mm, measured 0,019s after contact, and 0,112s (final)

Motivation

Setup/Processes

Test Series

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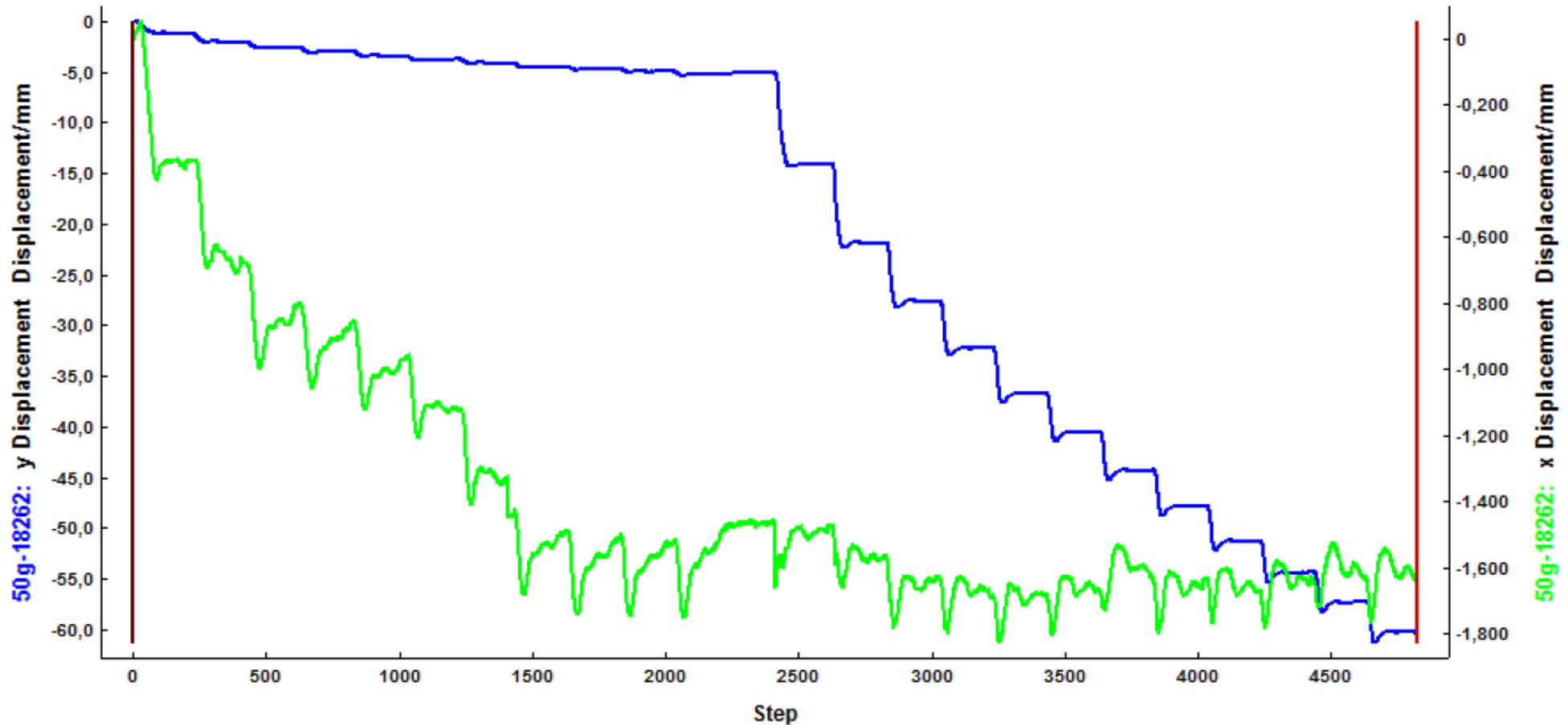


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Test station M, evaluation of 24 drops, directed displacements of one point 0.25m below initial surface (near sensor 50g 18262)

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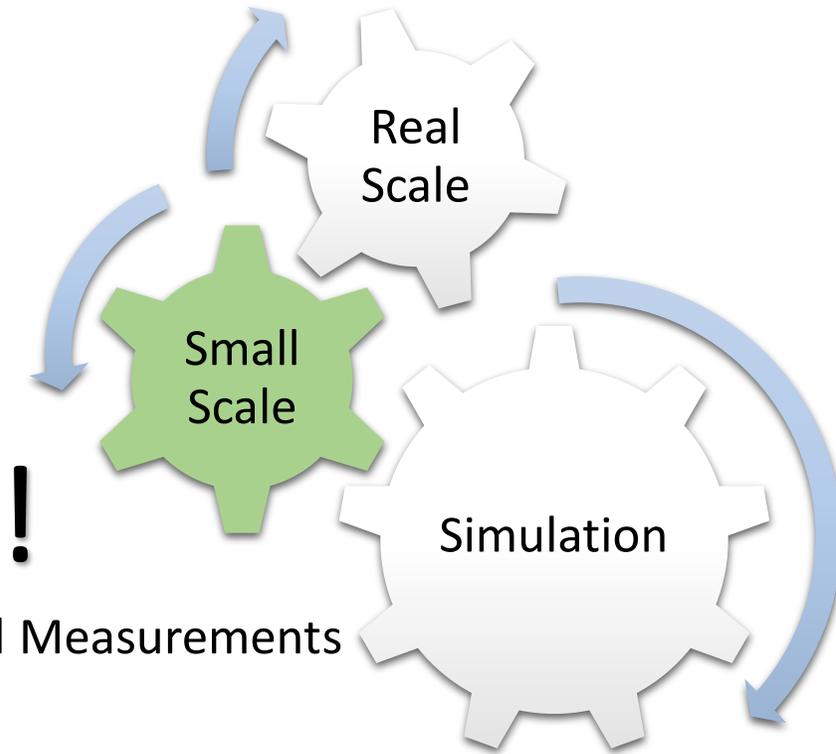
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Optical and Physical Measurements





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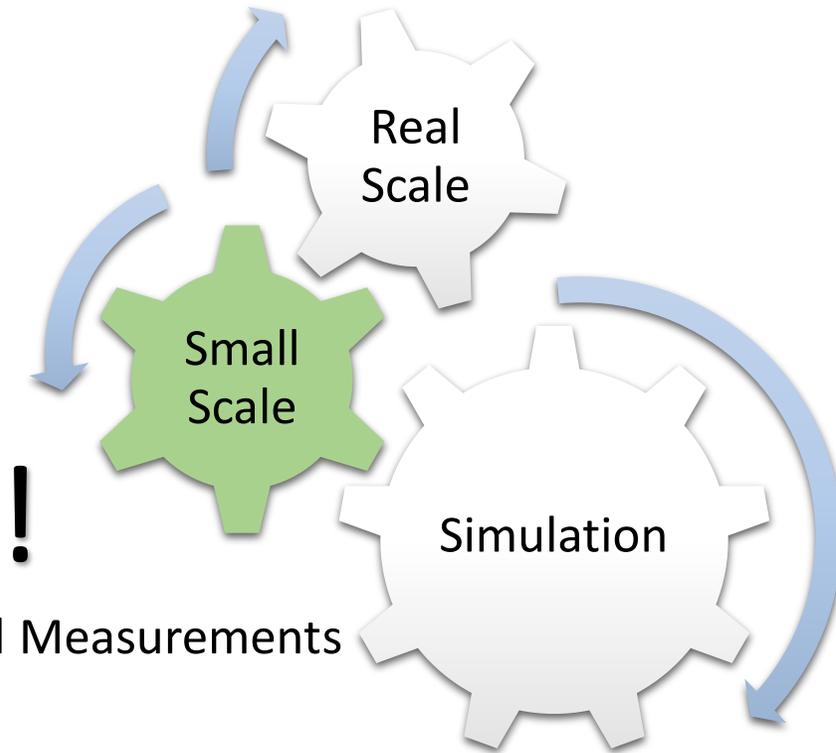
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Optical and Physical Measurements

Abaqus Explicit

Hypoplastic model for granular materials von Wolffersdorff [1] (basic model), Niemunis and Herle [2] (small-strain extension)

[1] P. A. von Wolffersdorff.

A hypoplastic relation for granular materials with a predefined limit state surface. *Mechanics of Cohesive-Frictional Materials*, 1(3):251-271, 1996.

[2] A. Niemunis and I. Herle.

Hypoplastic model for cohesionless soils with elastic strain range. *Mechanics of Cohesive-Frictional Materials*, 2(4):279-299, 1997.

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