



**HAL**  
open science

## Abdominal Injury and submarining prediction, ABISUP collaborative project

Philippe Beillas, François Bermond, Philippe Petit, Sabine Compigne, Jocelyn Perisse, Olivier Richard, Jerry Wang, Paul Lemmen, Pascal Baudrit

### ► To cite this version:

Philippe Beillas, François Bermond, Philippe Petit, Sabine Compigne, Jocelyn Perisse, et al.. Abdominal Injury and submarining prediction, ABISUP collaborative project. Visite HCERES, Feb 2020, Bron, France. Visite HCERES, 1 p, 2020. hal-02509307v2

**HAL Id: hal-02509307**

**<https://hal.science/hal-02509307v2>**

Submitted on 19 Apr 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Abdominal Injury and submarining prediction ABISUP collaborative project

Philippe Beillas<sup>1</sup>, François Bermond<sup>1</sup>, Philippe Petit<sup>2</sup>, Sabine Compigne<sup>3</sup>, Jocelyn Perisse<sup>4</sup>,  
Olivier Richard<sup>5</sup>, Jerry Wang<sup>6</sup>, Paul Lemmen<sup>6</sup>, Pascal Baudrit<sup>7</sup>

<sup>1</sup>Univ Lyon, Université Claude Bernard Lyon 1, Univ Gustave Eiffel, IFSTAR, LBMC UMR\_T 9406, F-69622, Lyon

<sup>2</sup>GIE PSA-RENAULT, <sup>3</sup>TME, <sup>4</sup>TRANSPOLIS, <sup>5</sup>FAURECIA, <sup>6</sup>HUMANETICS, <sup>7</sup>CEESAR

## Context - Aims

- THOR dummies in preparation for consumer testing (NCAP...)
- Submarining and abdominal injuries remain issues (rear occupant, new seating in future automated vehicles...)
- Objectives: improve dummy response, submarining and abdominal injury prediction for the small occupant (future 5<sup>th</sup> percentile female THOR) and current THOR 50<sup>th</sup> percentile male
- Collaborative project 2016-2020

## Methods

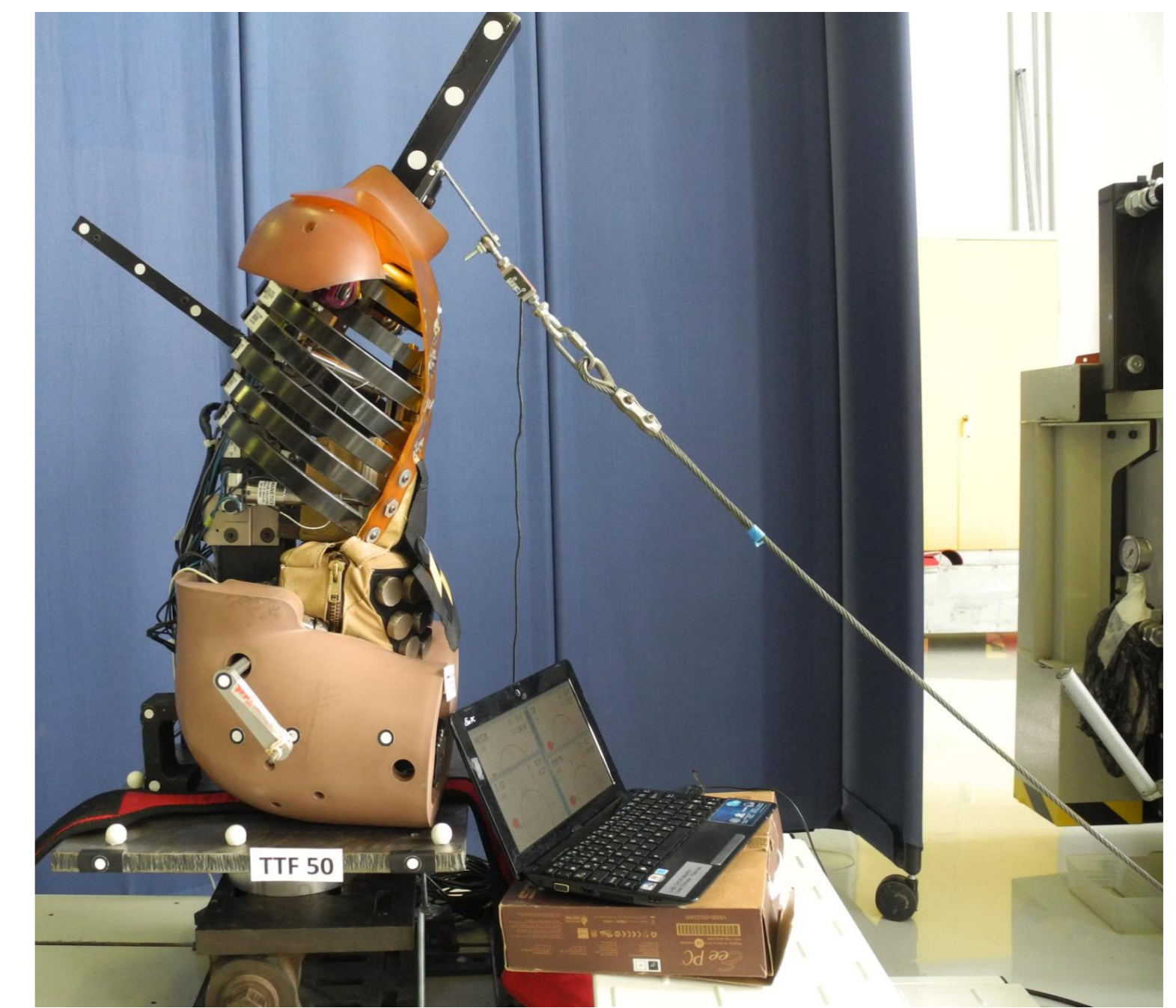
- Formulate dummy specifications for pelvis, lumbar spine and abdomen (biomechanical requirements)
- Develop CAD & prototypes (with Abdominal Pressure Twin Sensors)
- Evaluate prototypes of the 50<sup>th</sup> male and new 5<sup>th</sup> female THOR dummies in various testing at multiple partners
- Propose submarining predictors and abdominal injury criteria

## LBMC Results

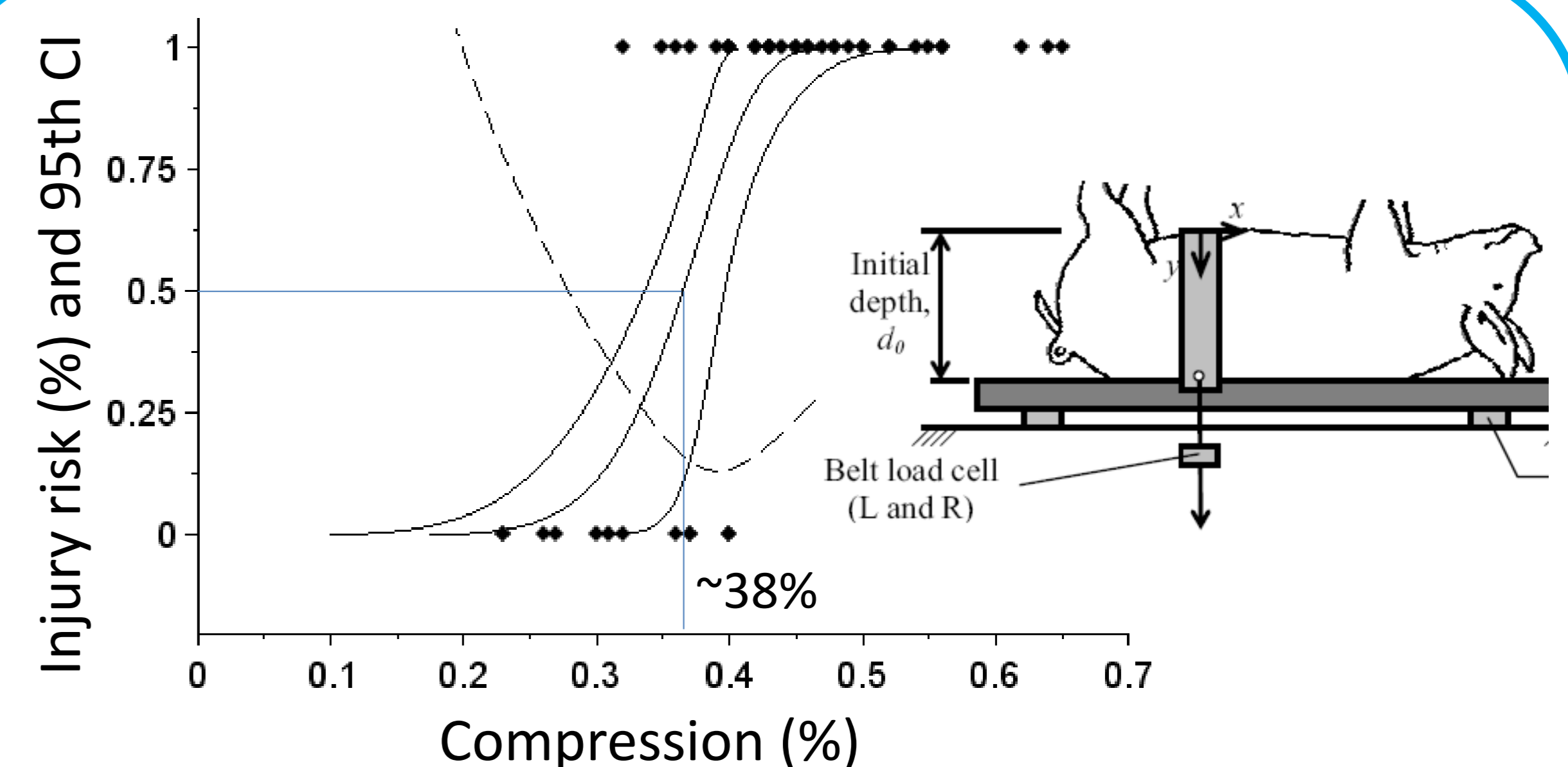
- Characterize the sensitivity of the response and injury predictors to the loading conditions (magnitude and orientation)
  - Including a preliminary simulation study
  - 50<sup>th</sup> male completed. 5<sup>th</sup> female in preparation
- Perform matching test to prepare the definition of abdominal risk curves

## Related project: ENOP (2019-2021)

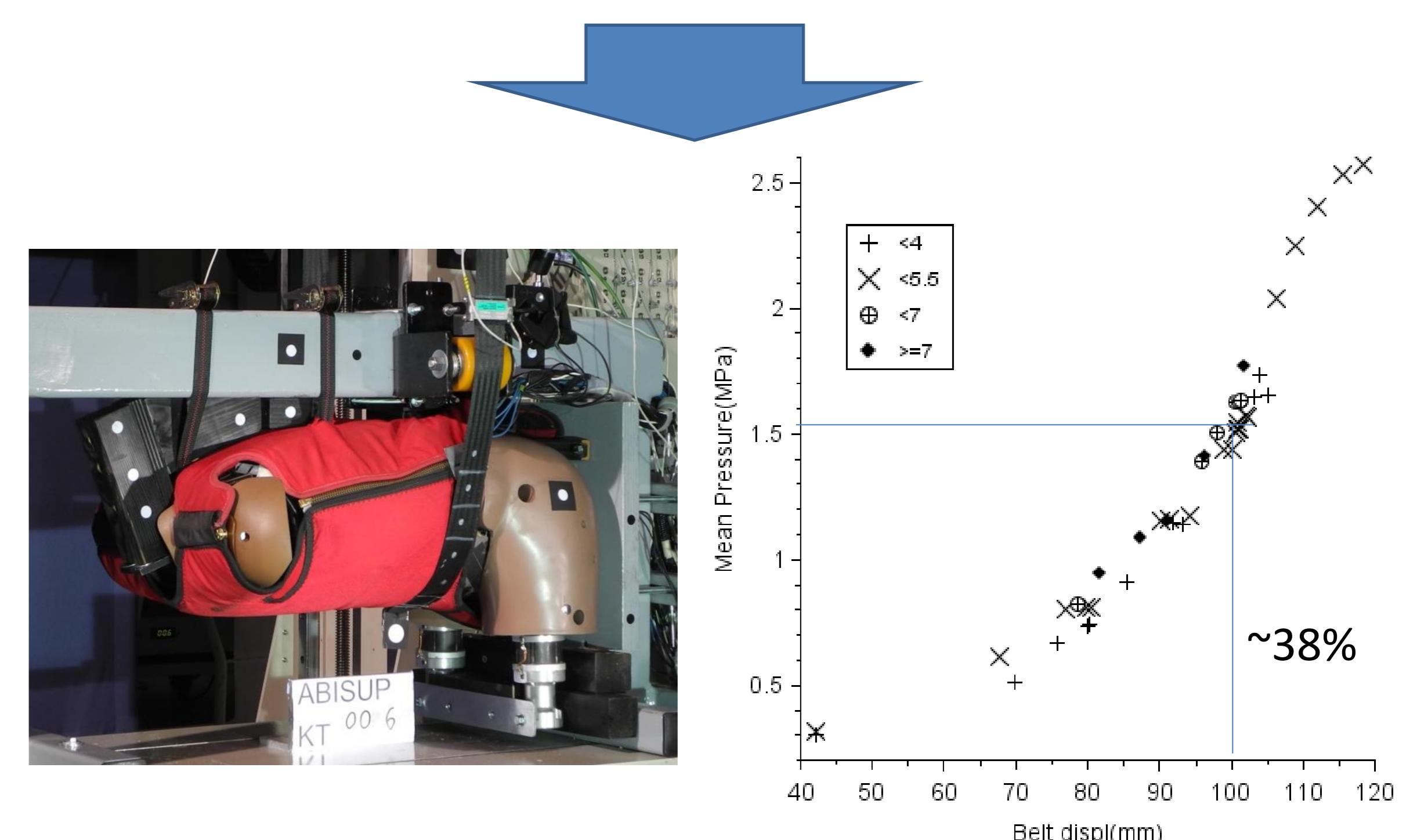
- Enable New Occupant Postures: assess submarining and injury risk in seating configurations possibly used in future Highly Automated Vehicle**
  - Collect data in tests with PMHS (Post Mortem Human Surrogates) in **Swiveled** and **Reclined** configurations
  - Use results to **validate HBM responses** (coll. SURCA) and **specify Thor modification kit** for new postures
  - Evaluate new prototype
- Same partnership + Autoliv Research, BaST and close collaboration with NHTSA funded similar effort



THOR Torso flexion test (thoraco abdominal coupling assessment)



Kent et al. (2006, 2008) porcine tests with risk curve



Reproduction of the tests for risk curve scaling

## THOR compression test

**Acknowledgement – Collaboration** The work is conducted in close collaboration with the National Highway Traffic Safety Administration (NHTSA), Vehicle Research and Testing (VRTC), US DoT, Virginia Tech, and Ohio State University