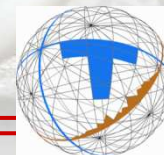


Comparison of inline skates regarding plantar pressure and oxygen uptake

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Nachbauer W.



TECHNOLOGIEZENTRUM
SKI- UND ALPINSPO

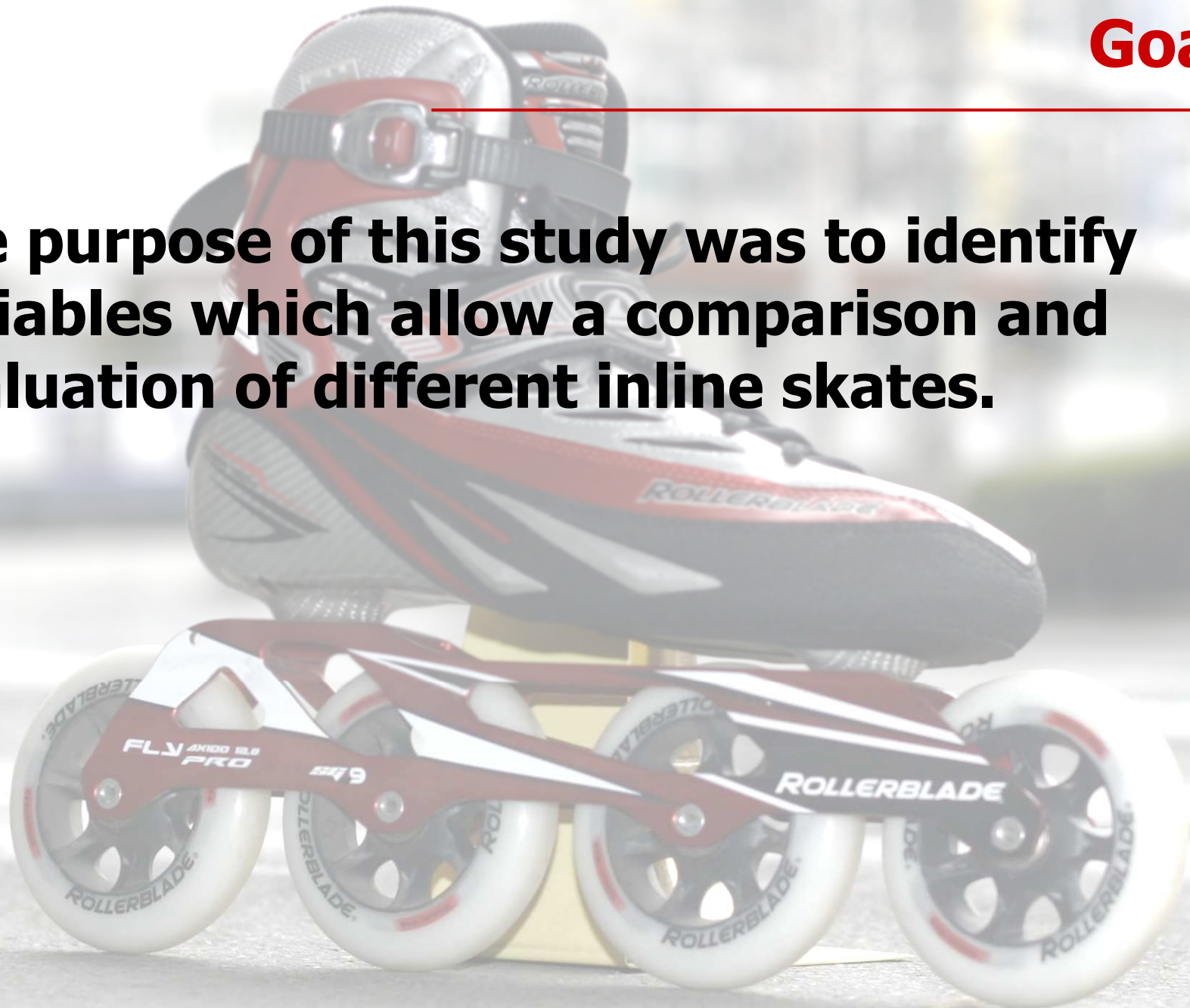


Introduction

- **Injury patterns** (Hilgert et al., 1998, Knox et al., 2006, Fasciglione et al., 2007, Mulder and Hutten, 2002)
 - **Protective equipment** (Kroncke et al., 2008)
 - **Physiological demands** (Krieg et al., 2006, Schulz et al., 1996, Martinez et al., 1993)
 - **Biomechanical research** has focused on isolated problems such as plantar pressure measurement or attenuation during inline skating (Eils and Jerosch, 2000, Mahár et al., 1997).
-

Goal

The purpose of this study was to identify variables which allow a comparison and evaluation of different inline skates.



Data collection

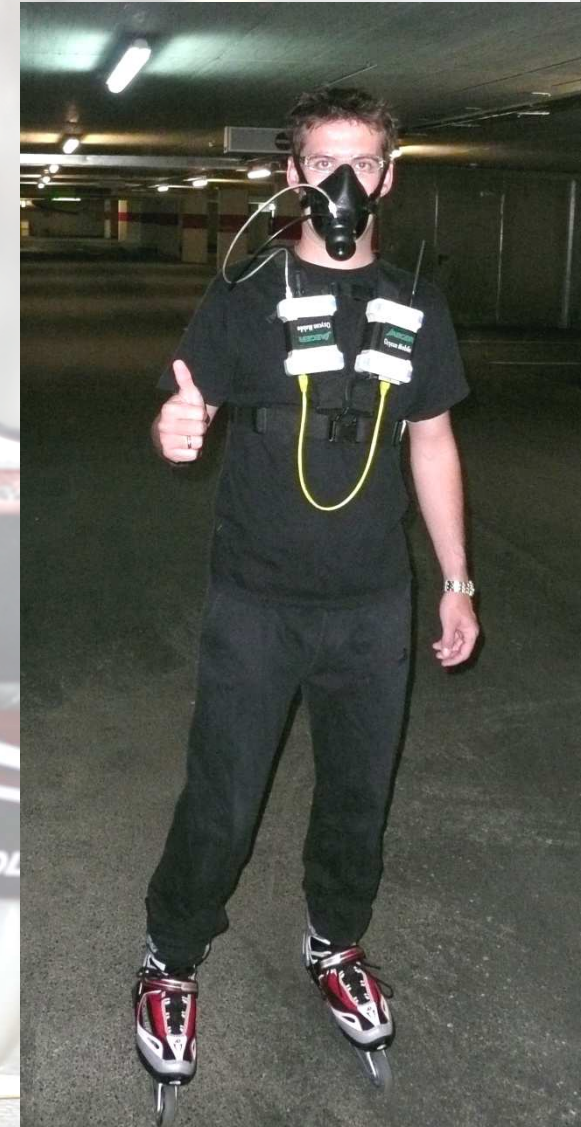
- **8 subjects**
 - beginners or intermediate inline skaters
- **8 inline skates**
 - different non-modified retail models



Spiroergometry

**Test 1: 3min run, $v = 5\text{m/s}$,
open spirometric system
(Oxygen mobile, Viasys)**

- **Oxygen uptake (VO_2)**
- Carbone dioxide output (VCO_2)
- Heart rate (HR)
- Total ventilation (VE)
- Energy expenditure (EE)



Plantar pressure distribution

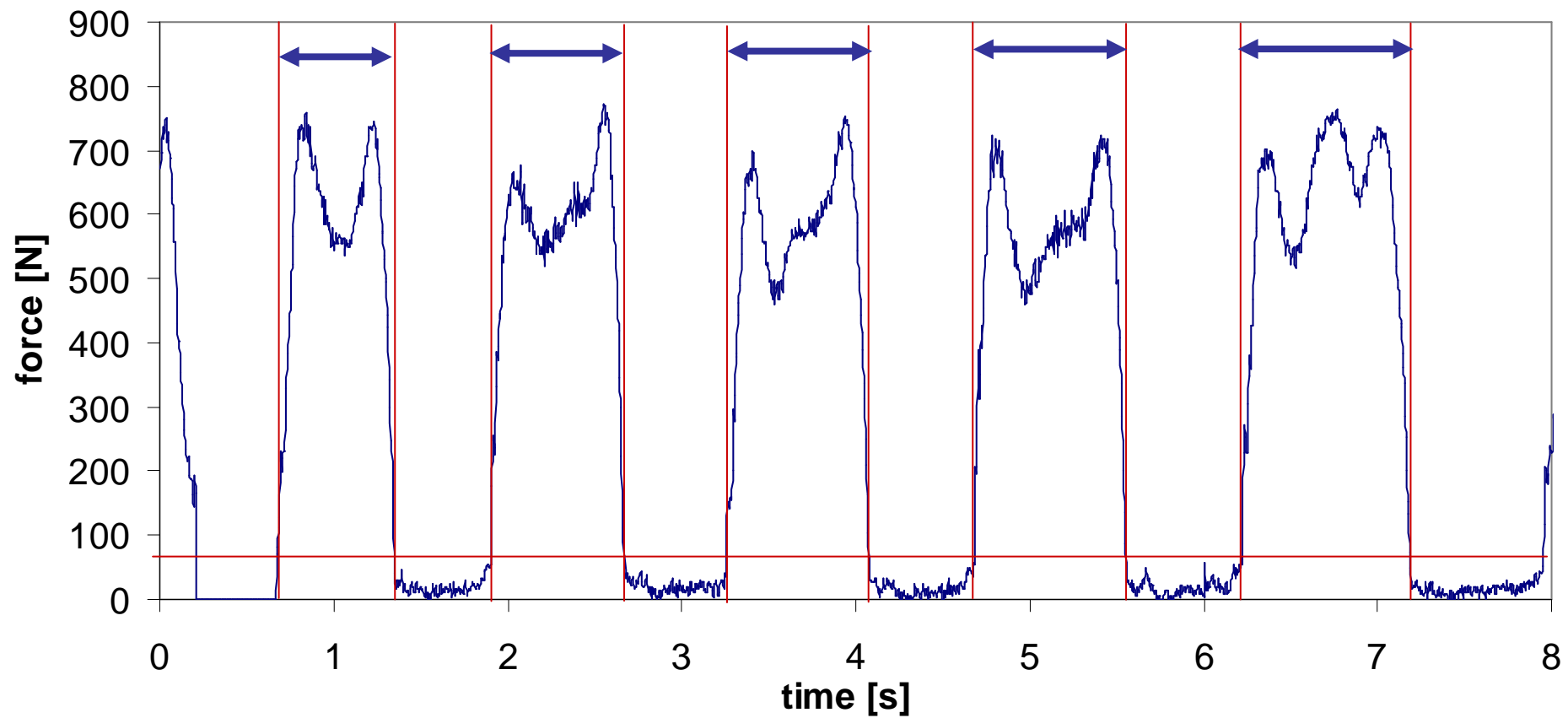
Test 2: 60s run, $v = 5\text{m/s}$
Paromed System (Pressure insoles, 24 sensors each, 200Hz)

- Mean step duration
- Mean maximum force
- Mean push off force
- Mean force gradient
- Variation of force
- Variation of point of force application
- Calculated for right and left foot
- Test repetition after one week



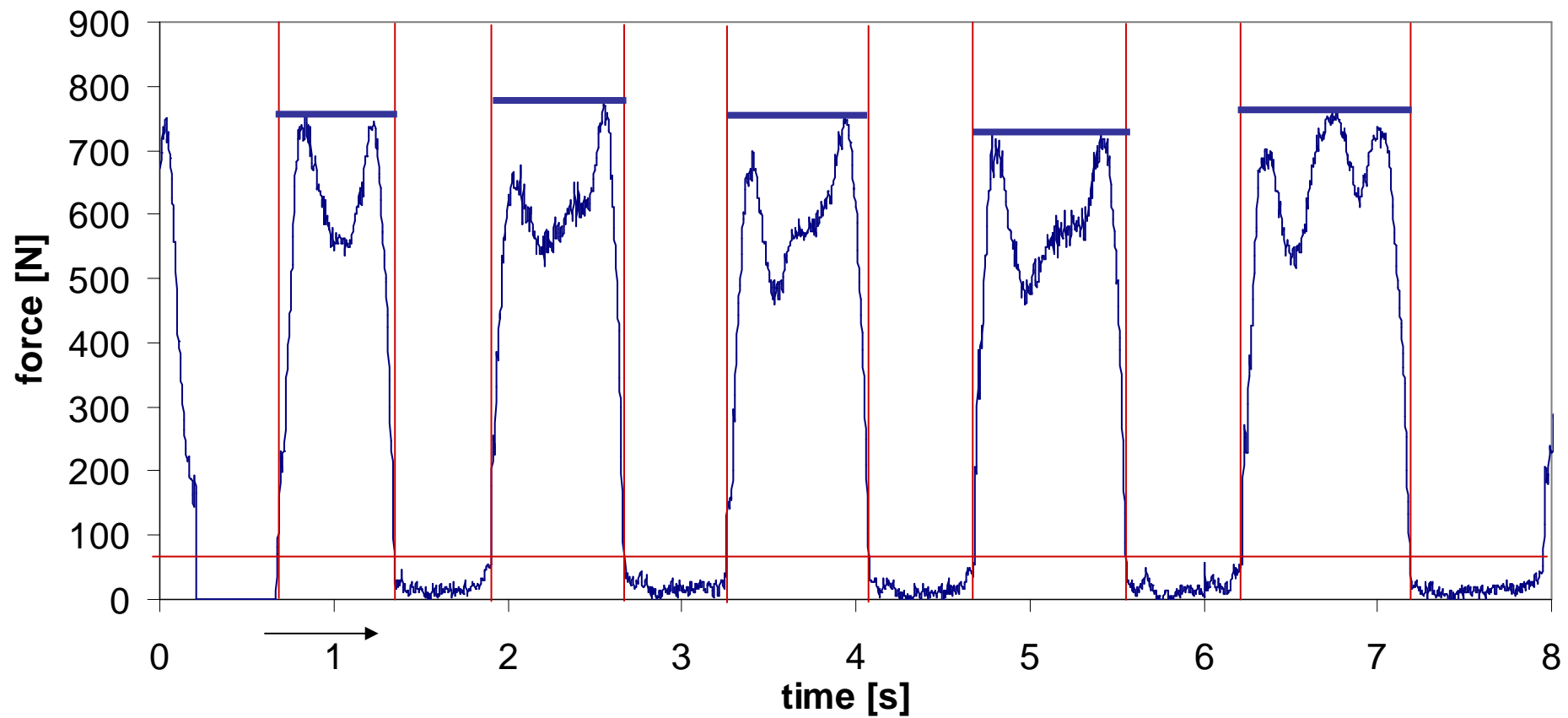
Force variables

- Mean step duration



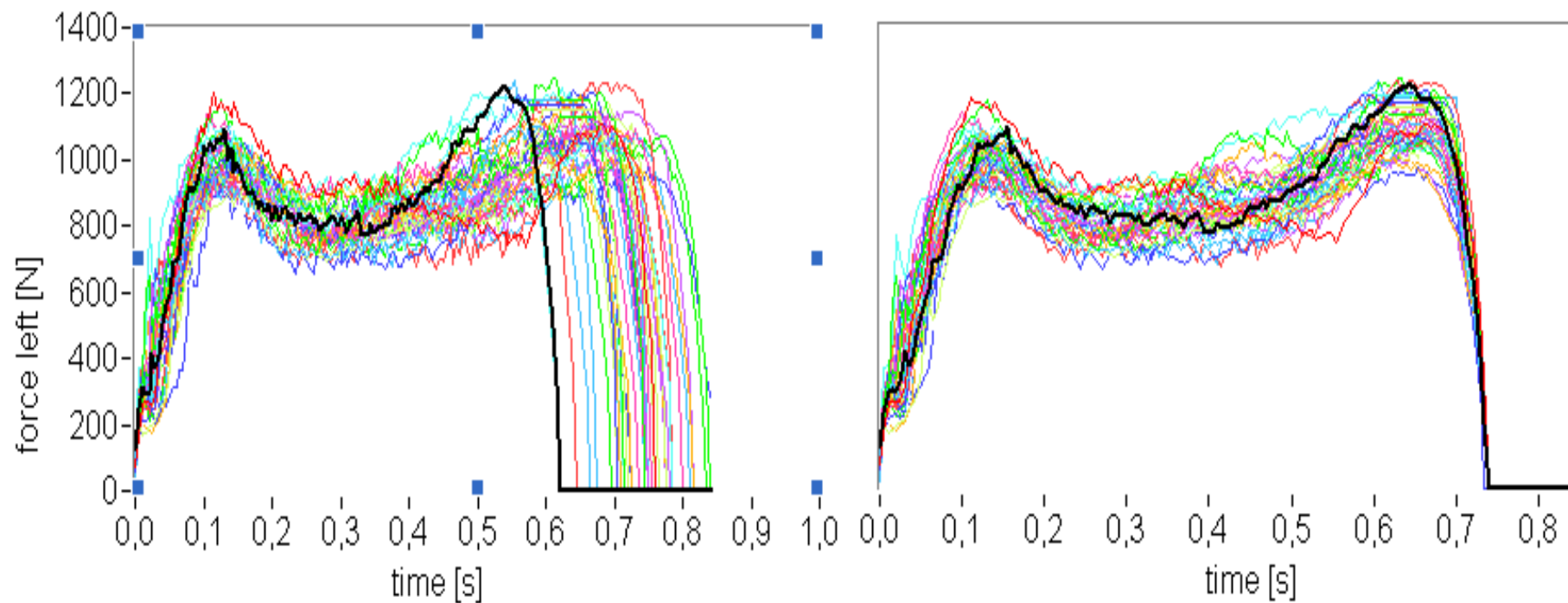
Force variables

- Mean maximum force



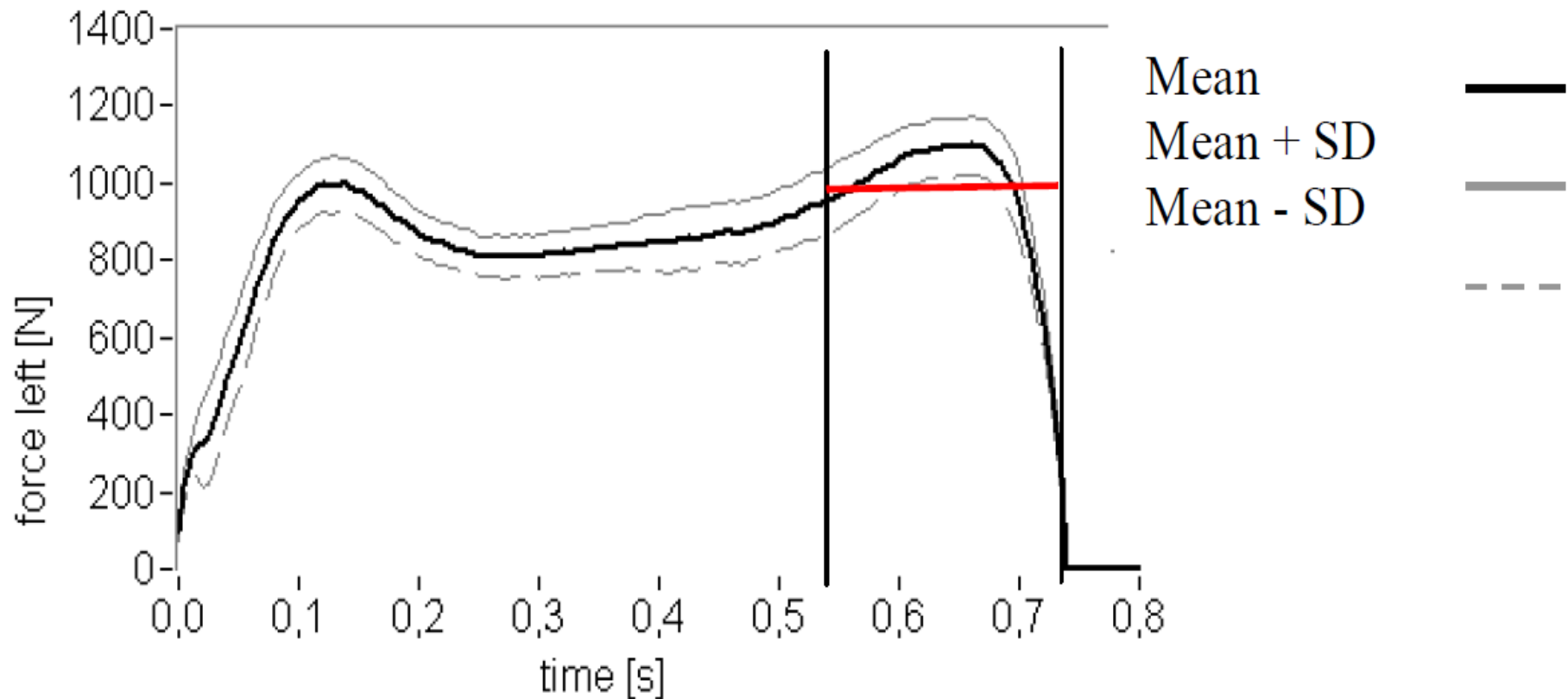
Force variables

- **Time-Normalization**



Force variables

- **Mean push off force**
mean force of the last 0.2s of the normalized step



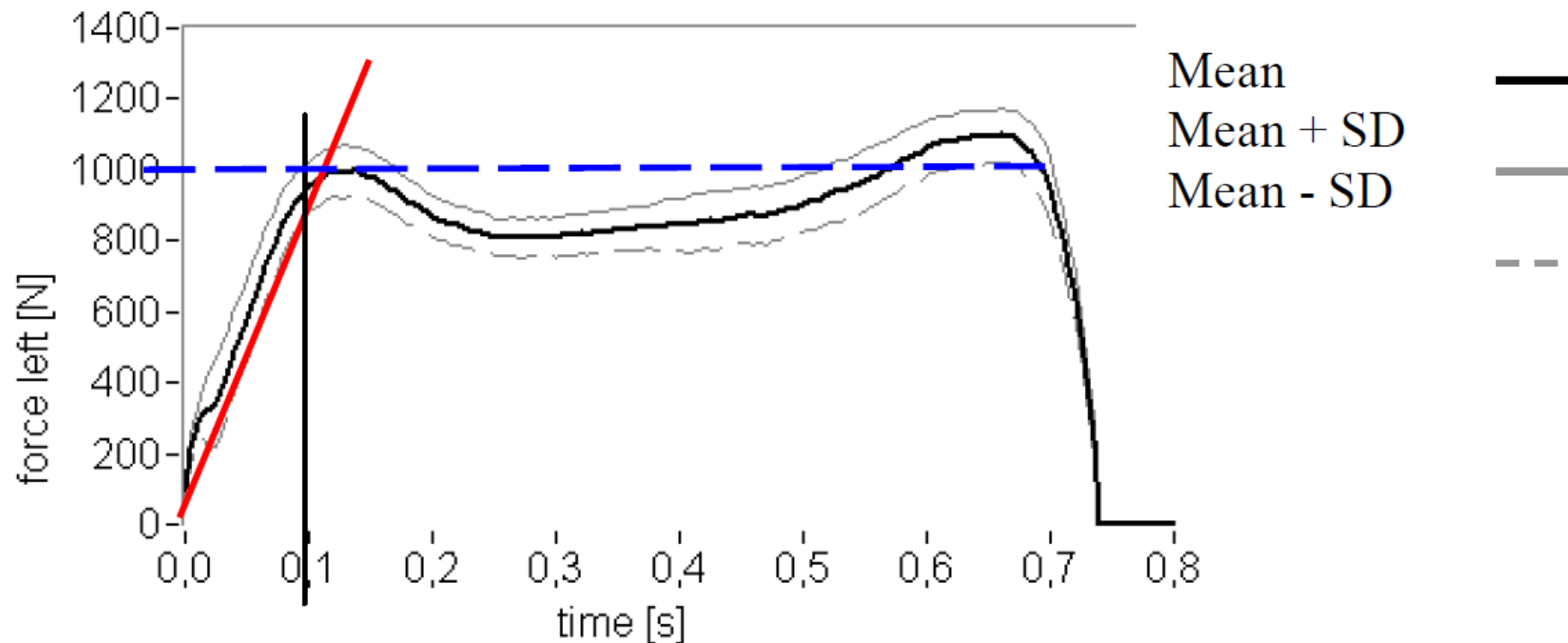
Force variables

- **Mean force gradient**

$$FG = (F_{0.1} - F_0) / 0.1$$

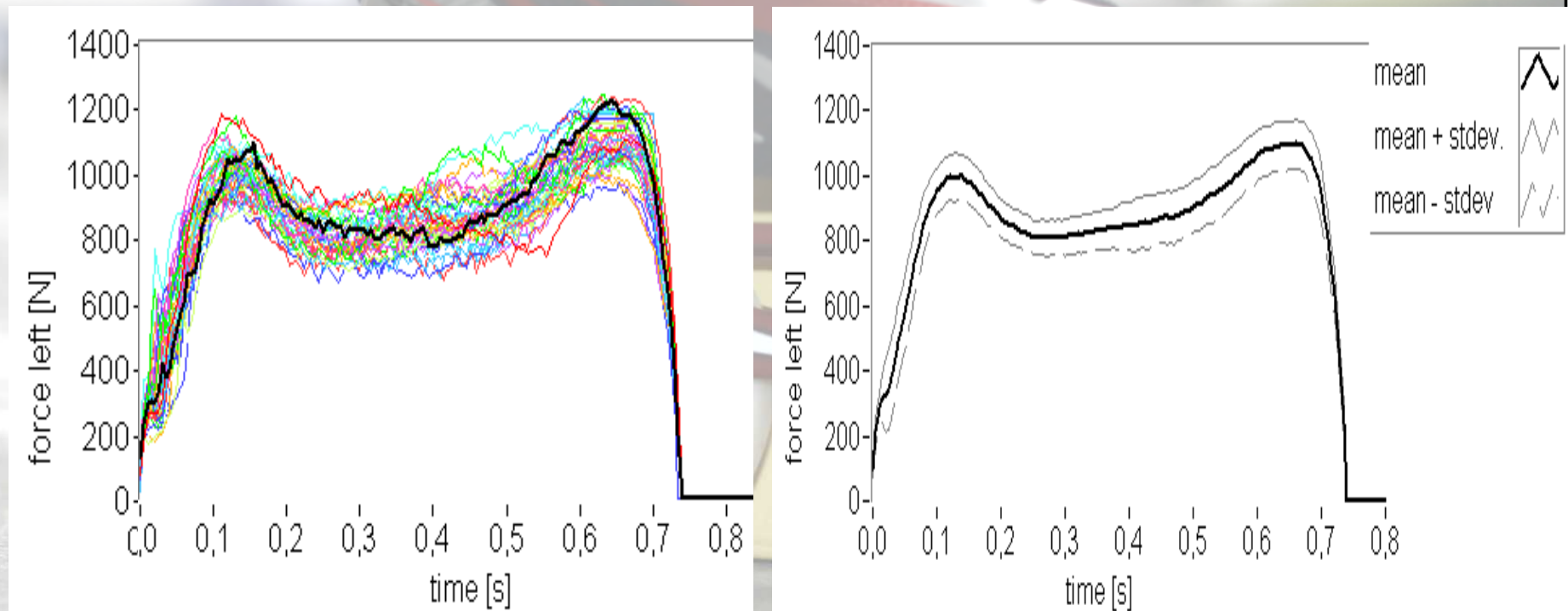
F_{0.1} ... force at 0.1s

F₀ ... force at 0s (first contact point)



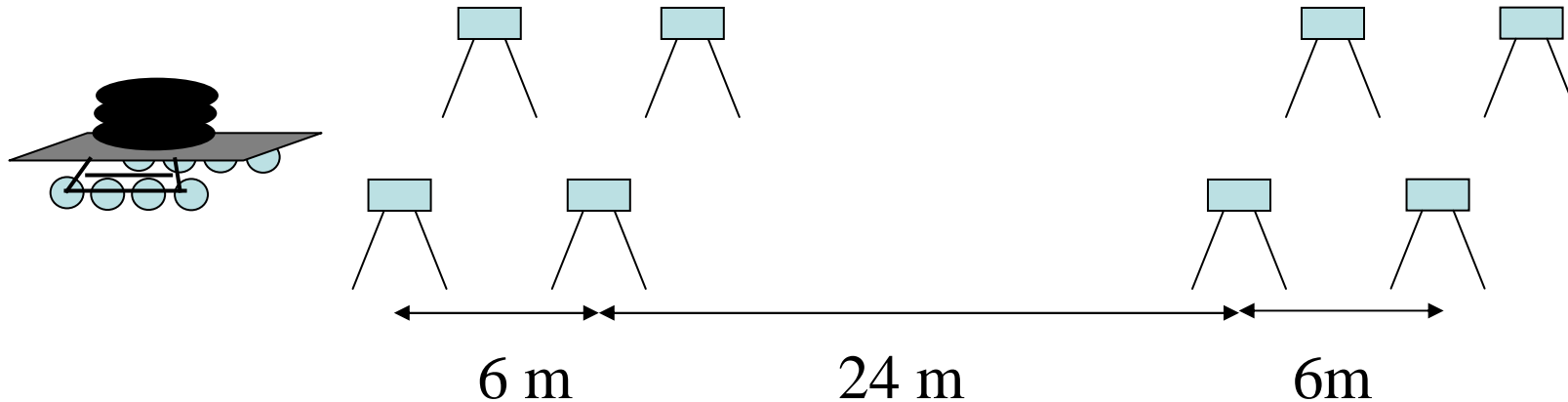
Force variables

- **Variation of force and point of force application**
 - **Mean standard deviation of the normalized curves**



Rolling friction

Test 3: Sledge (mass 65kg), 4 light barriers, numeric calculation of the rolling friction



Reliability of plantare pressure variables
Pearson correlation coefficients
between the repeated measurements

Pearson or Spearman correlation coefficients

- rolling friction**
- reliable plantare pressure variables**
- oxygen uptake**

Results

Reliability

mean step duration ($r_i=0.66$, $r_r=0.72$)

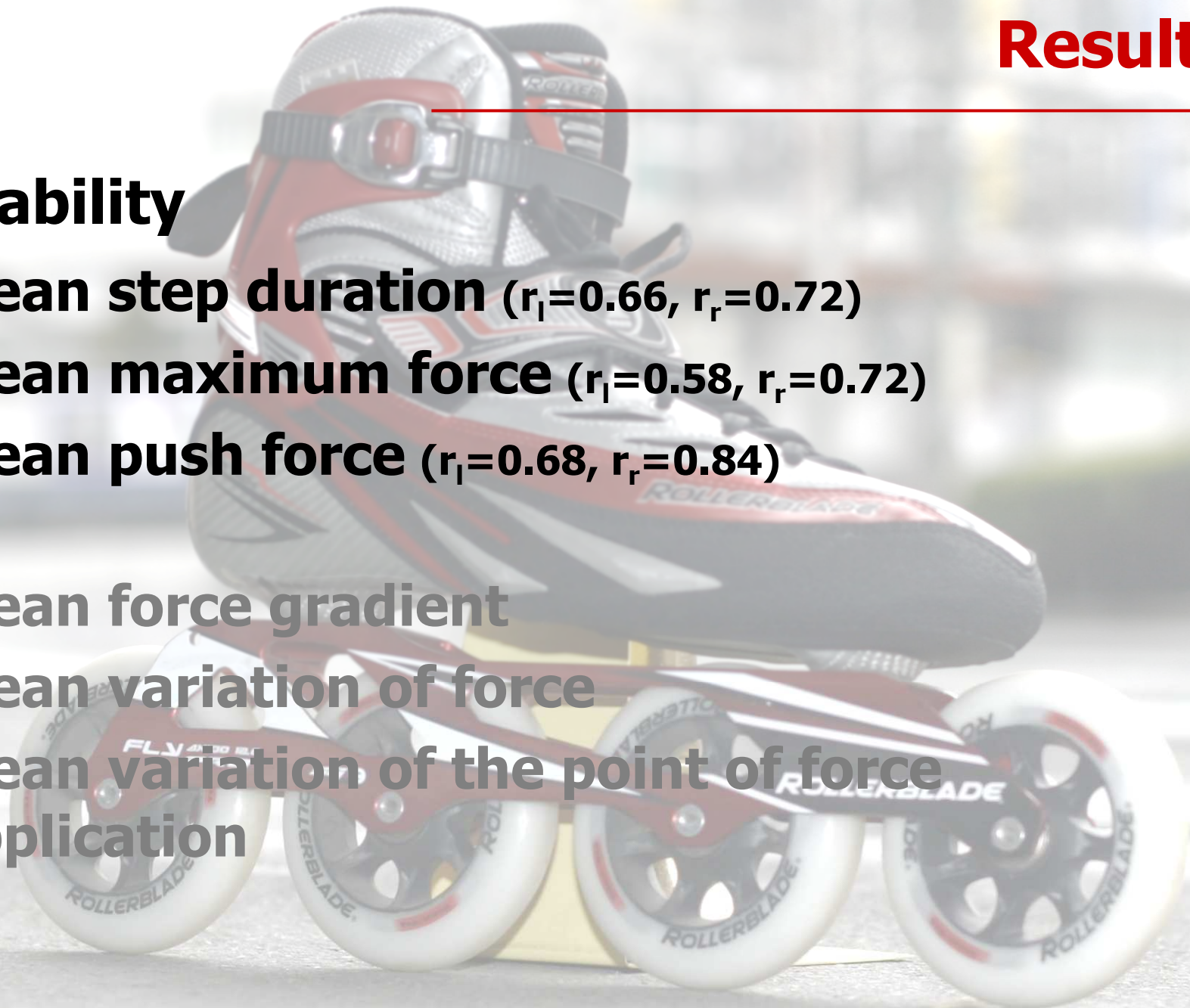
mean maximum force ($r_i=0.58$, $r_r=0.72$)

mean push force ($r_i=0.68$, $r_r=0.84$)

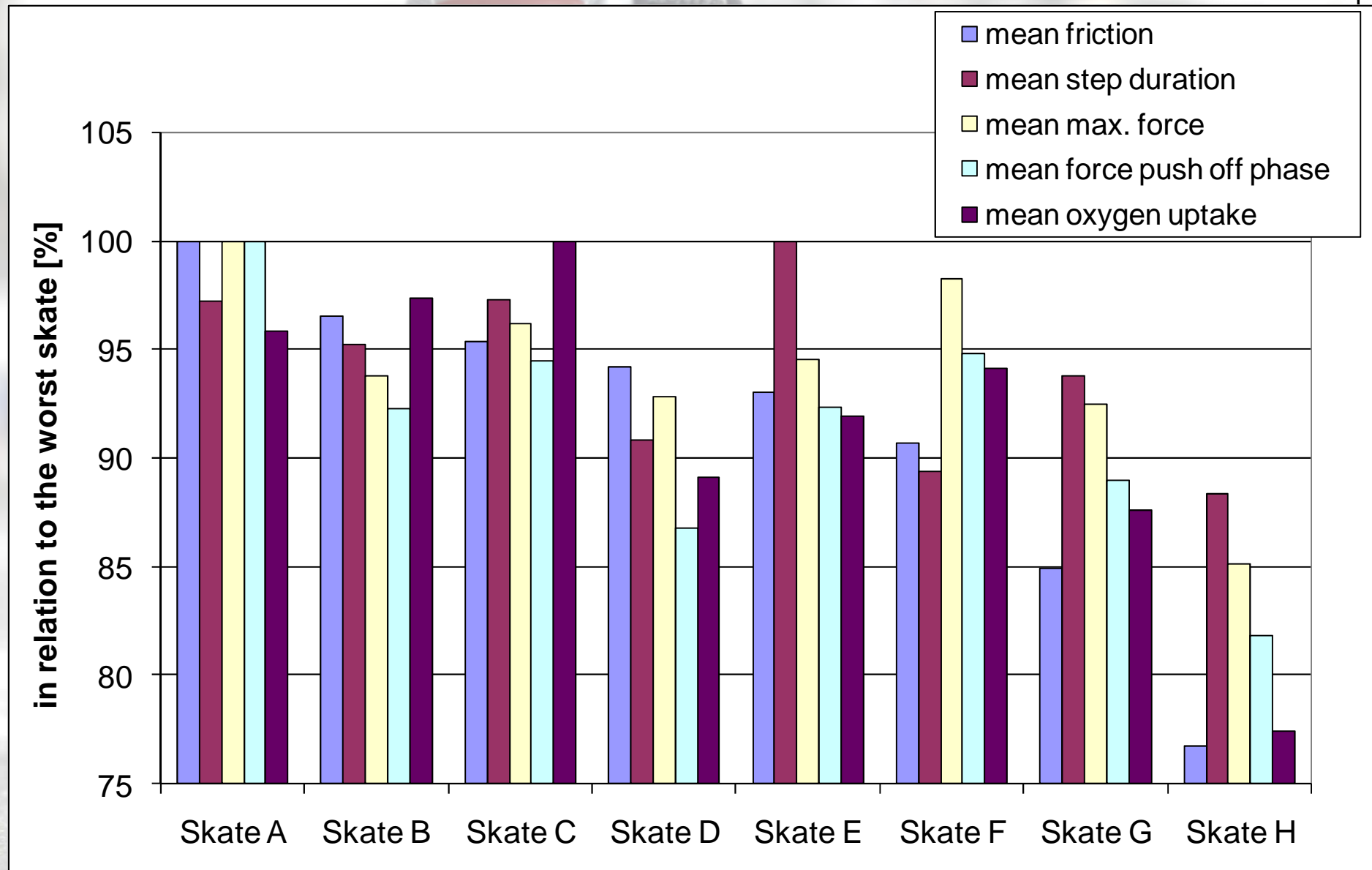
mean force gradient

mean variation of force

mean variation of the point of force application



Results



Results

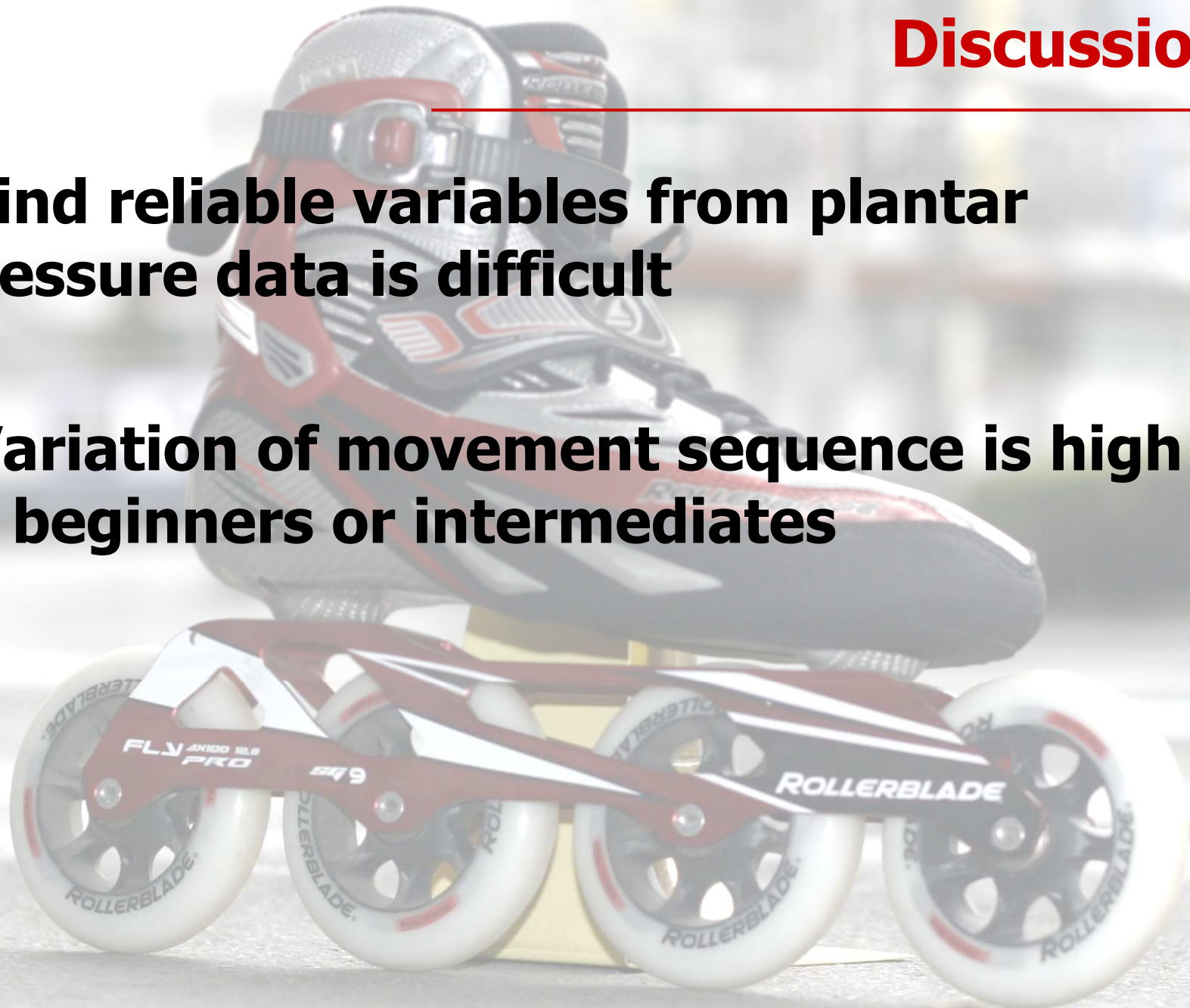
Correlation between the different variables

		mean step duration	mean max. force	mean push off force	oxygen uptake
friction	1	0,63	0,83	0,81	0,88
mean step duration		1	0,49	0,60	0,62
mean max. force			1	0,96	0,84
mean push off force				1	0,85
oxygen uptake					1

Discussion

To find reliable variables from plantar pressure data is difficult

→ Variation of movement sequence is high of beginners or intermediates



Discussion

Rolling friction determines strongly

- oxygen uptake**
- mean maximum force**
- mean push off force**



Discussion

→ inline skate construction without the base frame may have only a small effect on

oxygen uptake
mean maximum force
mean push off force



Discussion



mean step duration

- possible a parameter for the stability of inline skates
- only a middle correlation with the rolling friction

→ mean step duration may be a criteria for the stability of inline skates

This is supported by the feedback of the test persons:

“the shoe construction decisively affects the step duration”

Conclusion

For further studies

Identification of performance variables of the shoe of inline skates

- standardization of the base frame is necessary

Financially supported by





Thank you for your attention!