

WHICH HARDWARE CAN AID CLINICAL EXPERTS TO SUPPORT THEIR FOOT ANALYSIS?

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Our dream

Determine whether
foot characteristics
are determinable
by the eye, or
equipment is needed

2 questions

How consistent
are the current
analyses?

How well does the
equipment predict
the characteristics?



HOW TO SOLVE THESE QUESTIONS?

Measurements



77 healthy subjects



10 experts

CLINICAL ASSESSMENT

Experts assess feet as they do in their clinical practice and fill in a form



STATIC (visual + possibly using pressure plate/podoscope/blueprint):

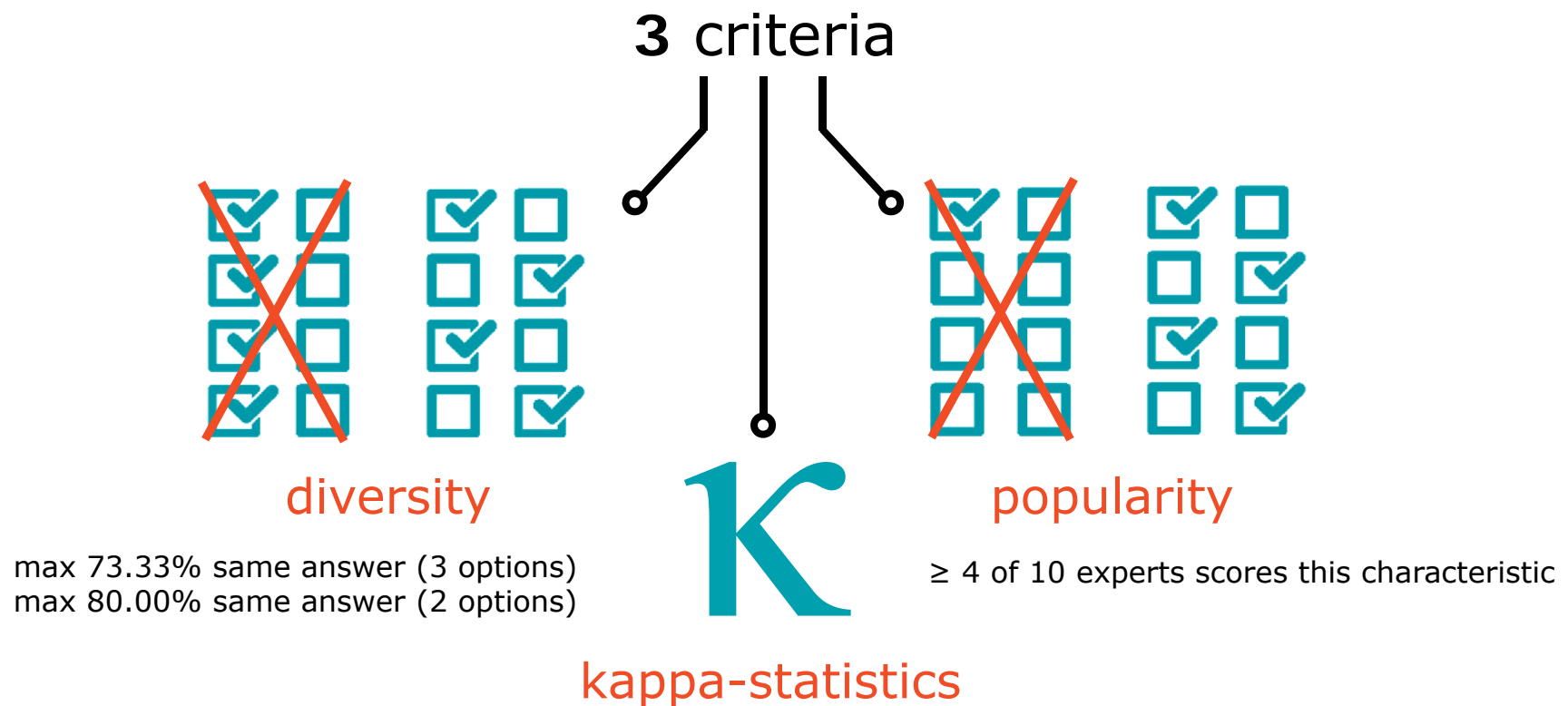
Leg length difference	<input type="checkbox"/> No	<input type="checkbox"/> <5mm	<input type="checkbox"/> >5mm
Knees frontal	<input type="checkbox"/> Varus	<input type="checkbox"/> Valgus	<input type="checkbox"/> Normal
Knees sagittal	<input type="checkbox"/> Flexion	<input type="checkbox"/> Extension	<input type="checkbox"/> Normal
Calcaneus in NCSP	<input type="checkbox"/> Varus	<input type="checkbox"/> Valgus	<input type="checkbox"/> Normal
Calcaneus (in RCSP)	<input type="checkbox"/> Varus	<input type="checkbox"/> Valgus	<input type="checkbox"/> Normal
Fore-hind foot	<input type="checkbox"/> Inverted	<input type="checkbox"/> Everted	<input type="checkbox"/> Normal
Longitudinal arch	<input type="checkbox"/> High	<input type="checkbox"/> Low	<input type="checkbox"/> Normal
Transverse arch	<input type="checkbox"/> High	<input type="checkbox"/> Low	<input type="checkbox"/> Normal
Position forefoot	<input type="checkbox"/> Abduction	<input type="checkbox"/> Adduction	<input type="checkbox"/> Normal
Position 1st ray	<input type="checkbox"/> Dorsiflexion	<input type="checkbox"/> Plantar flexion	<input type="checkbox"/> Normal
Hallux valgus	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> Extreme
Toes	<input type="checkbox"/> Hammer toes	<input type="checkbox"/> Claw toes	<input type="checkbox"/> Normal
Width forefoot with respect to the heel	<input type="checkbox"/> Wide	<input type="checkbox"/> Narrow	<input type="checkbox"/> Normal

Location calluses



ANALYSIS CLINICAL ASSESSMENT

Do all experts give the same score for each subject?



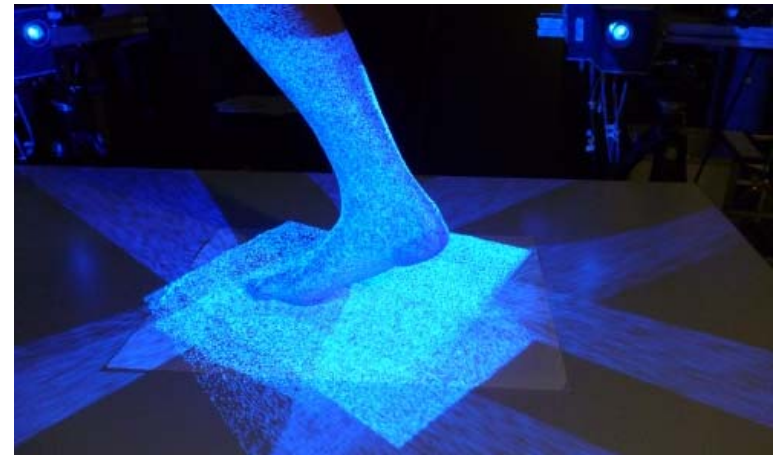
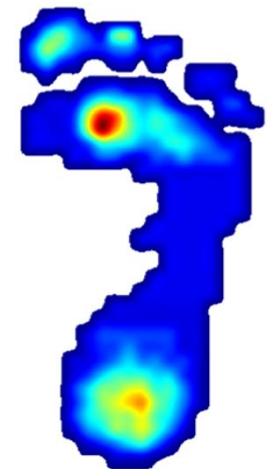
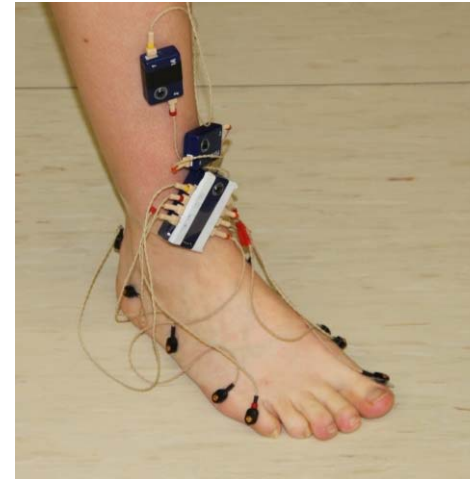
QUANTITATIVE MEASUREMENTS

Pressure plate

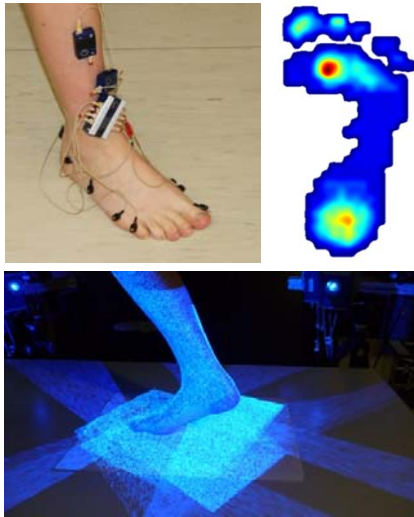
Dynamic 3D scanner

3D marker registration

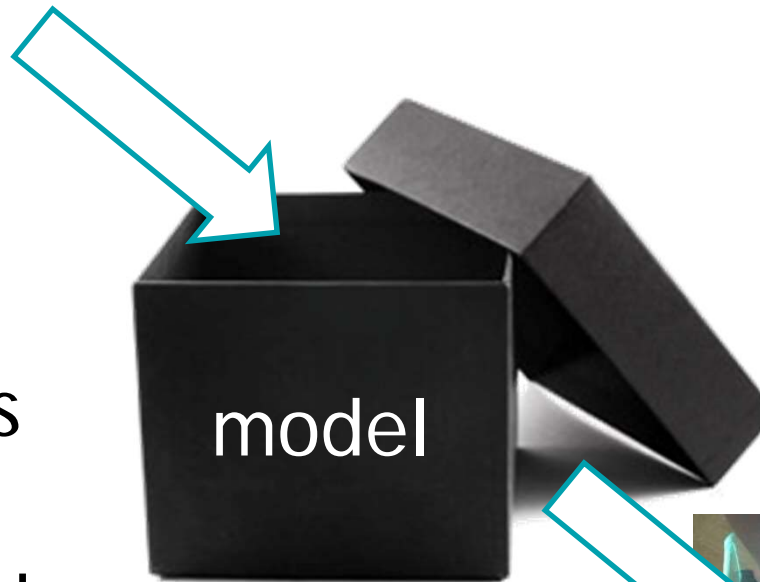
Force plate



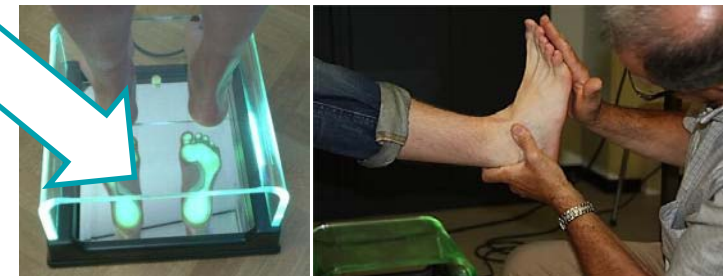
PREDICT CLINICAL USING FEATURES



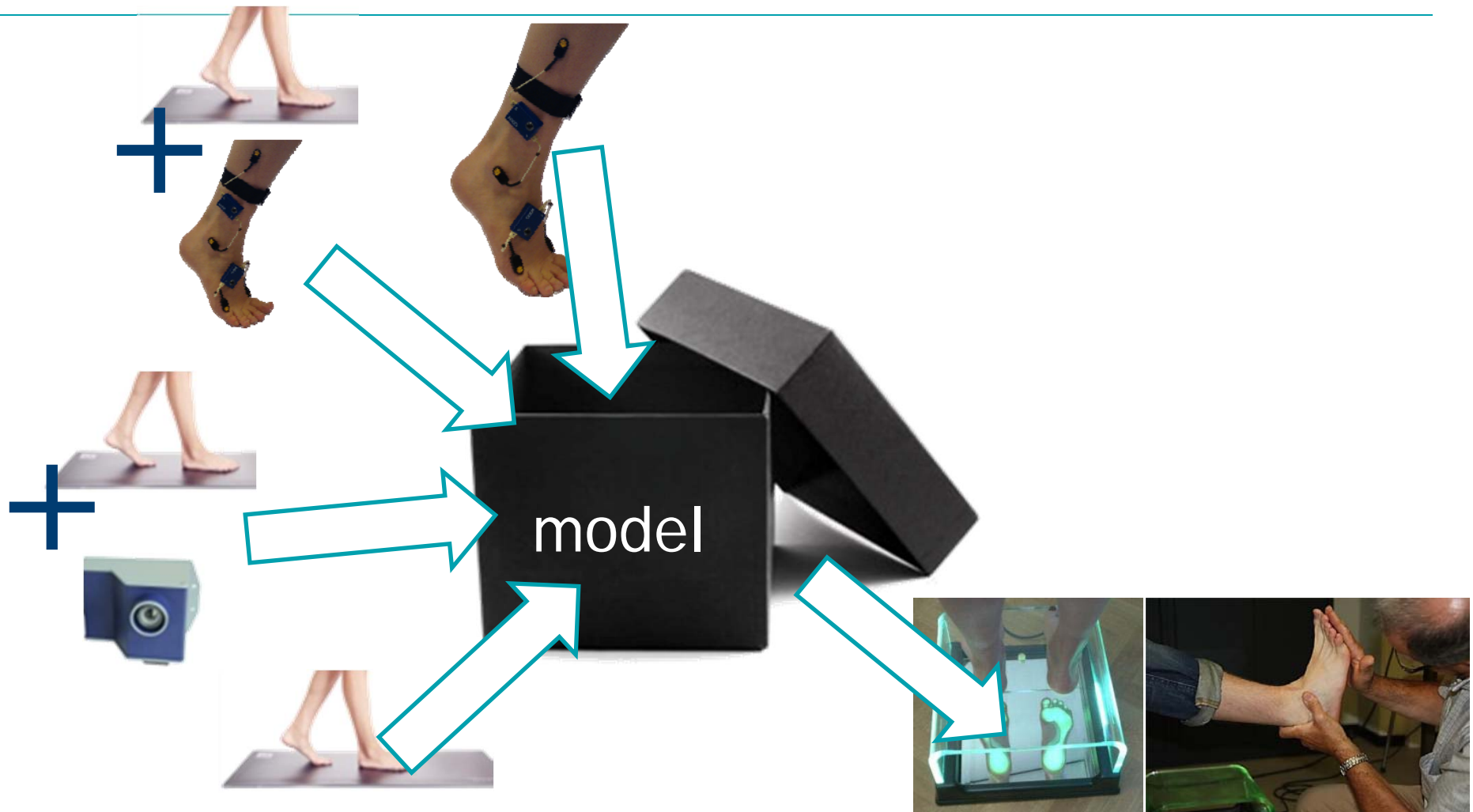
Use features
from
measurement
equipment ...



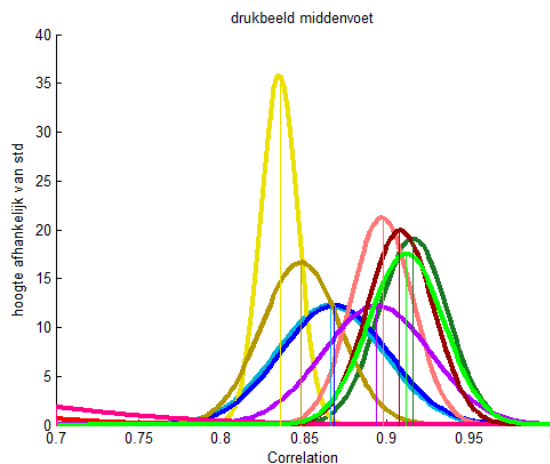
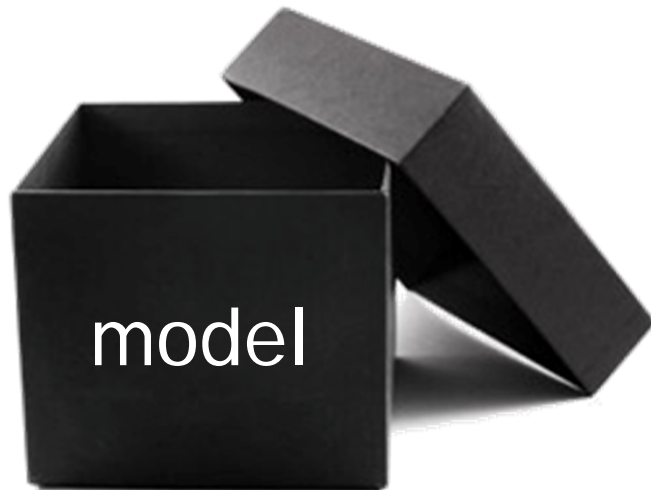
... to predict
clinical
characteristics.



EVALUATE DIFFERENTS SETUPS



WHAT MODEL?



- SVM (linear + RBF kernel)

epsilon-SVR for regression

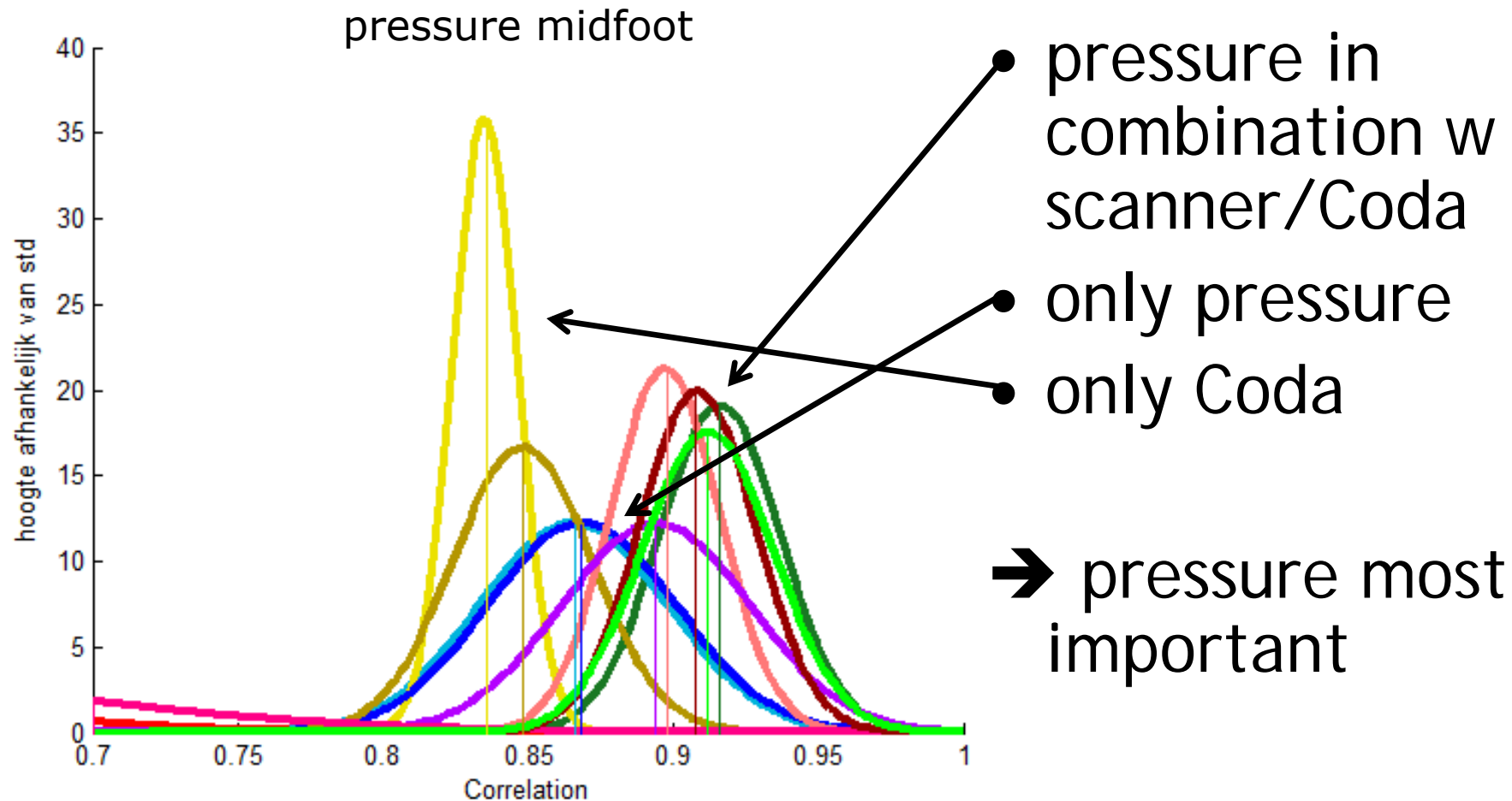
linear + RBF kernel

optimized using RMS-error

$$\left\{ \begin{array}{l} \epsilon: 0.1, 0.2, \dots, 0.8 \\ C: e^{-5}, -4.9, \dots, 3 \\ \gamma: e^{-6}, -5, \dots, -1 \end{array} \right.$$

- leave-one-out cross-validation
- repeated 10 times on randomized subset of dataset

HOW GOOD IS THE PREDICTION?



COMPARISON OF EQUIPMENT

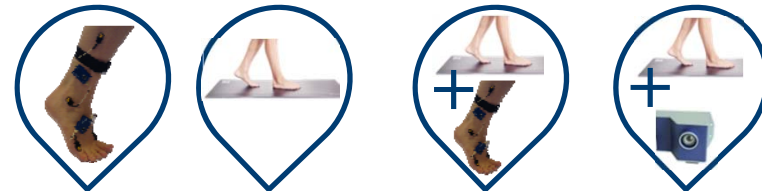
calcaneus RCSP



pressure midfoot



width
forefoot/heel



CONCLUSION

There is **no unique measuring system** that is perfect for the prediction of all foot characteristics

Sometimes specific hardware is good for the prediction of a characteristic, often a **combination of systems** is better

QUESTIONS & DISCUSSION

