

# Schwünge in Schräglagen - Untersuchung von Bewegungs- und Schwungparametern in fünf verschiedenen Lagen

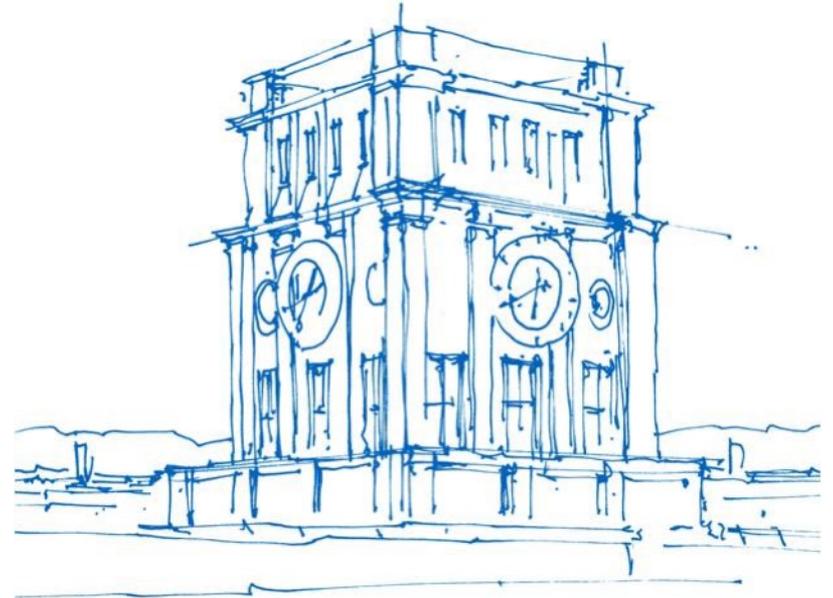
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Lehrstuhl für Trainingswissenschaft und Sportinformatik

Paderborn, 23. November 2019



*Uhrenturm der TUM*

# Einführung

- Golf Labor an der TUM
- Warum Schläge in Schräglage?
  - Ca. 80% aller Schläge im Golf werden aus einer Schräglage von  $+1^\circ$  bis  $10^\circ$  gespielt (Smith, Lauder, 2015)
- Forschungsstand
  - Bisher nur 2 Studien, die überhaupt Schräglagen untersucht haben
  - Was muss in Schräglagen beachtet werden?



## Studie 1:

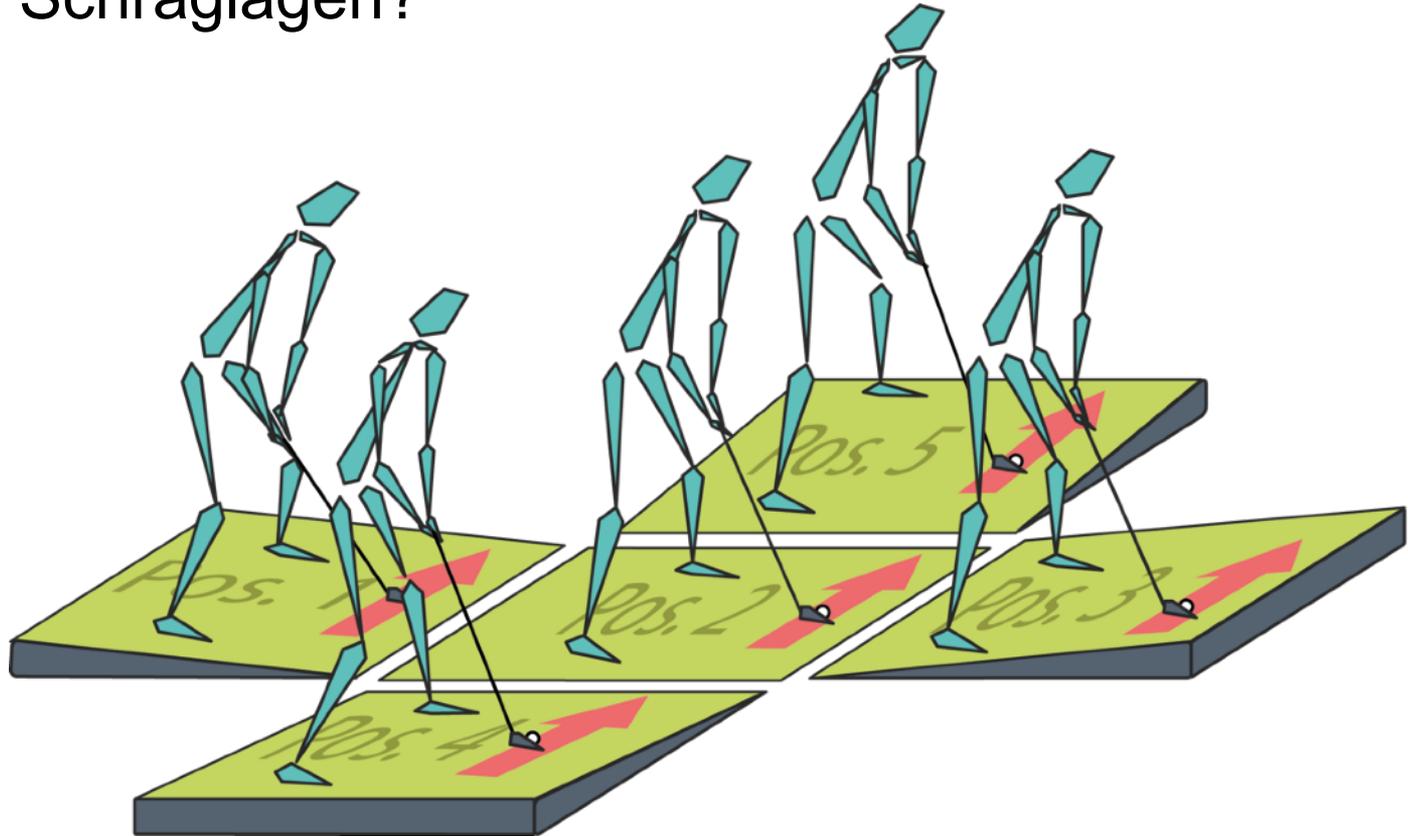
Analysis of the Golf Slope Shot by Ground Reaction (Kawashima, 1997)

## Studie 2:

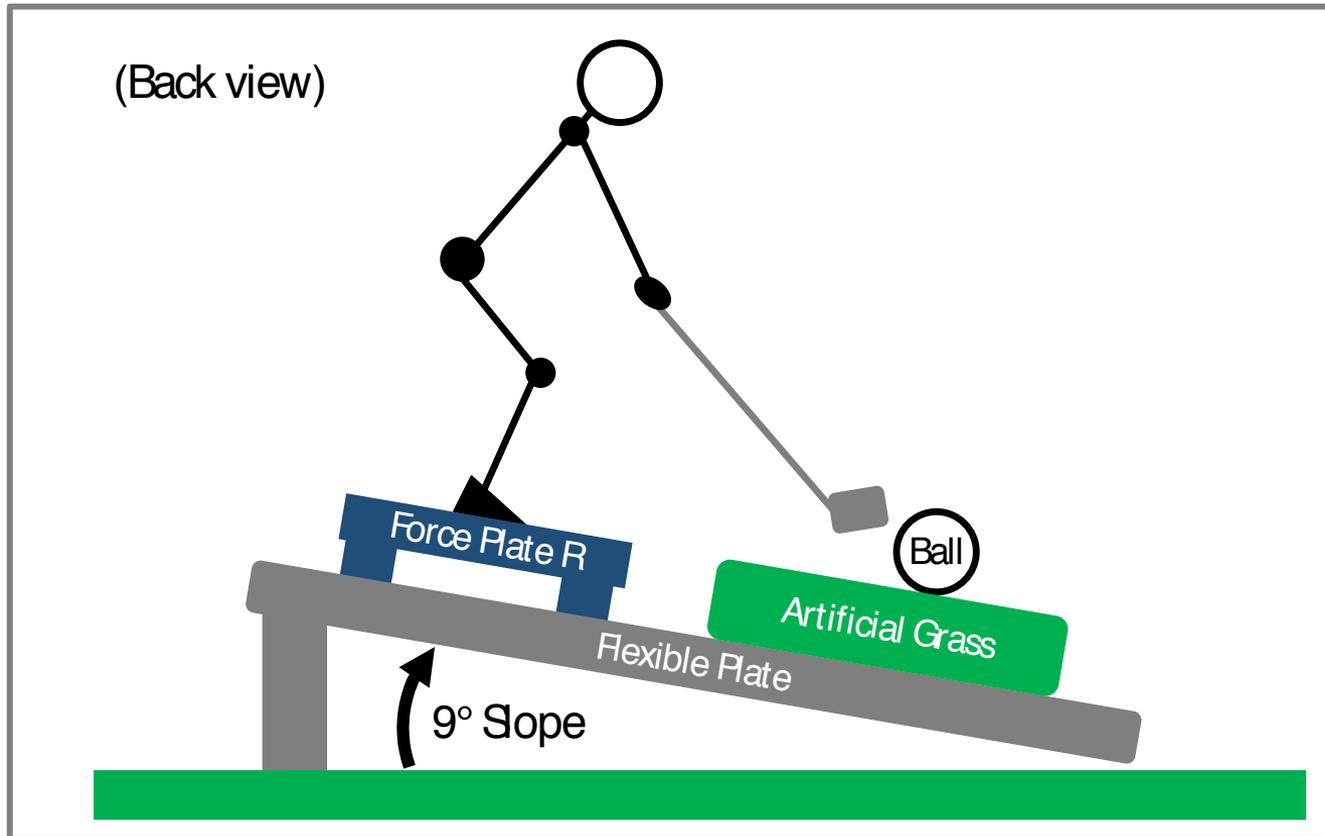
The Effect of Uphill and Downhill Slopes on Weight Transfer, Alignment and Shot Outcome in Golf (Blenkinsop et al., 2018)

# Methodik

# Welche Schräglagen?



# Schräglage / Aufbau – Position 1

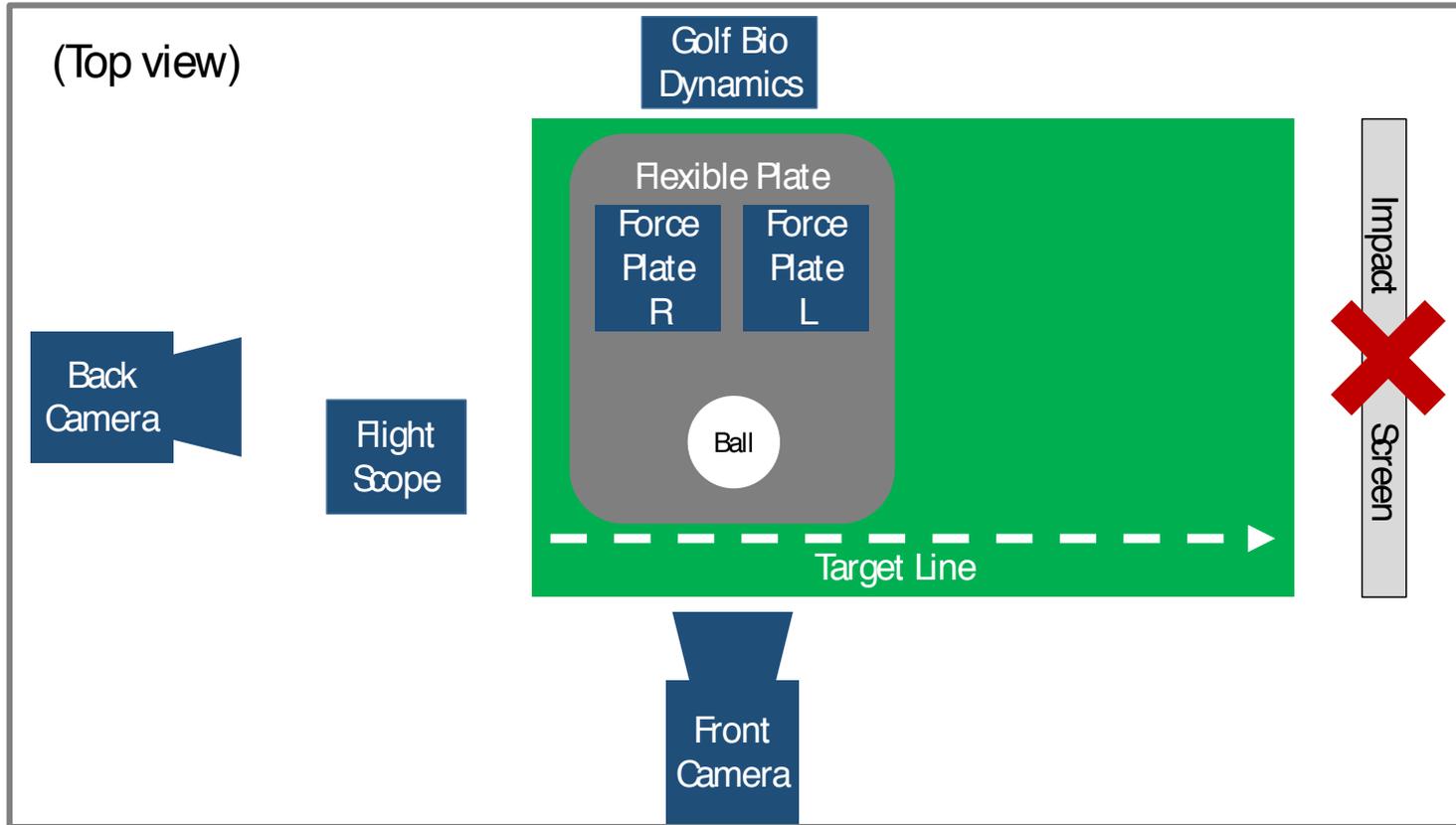


# Übersicht Messgeräte



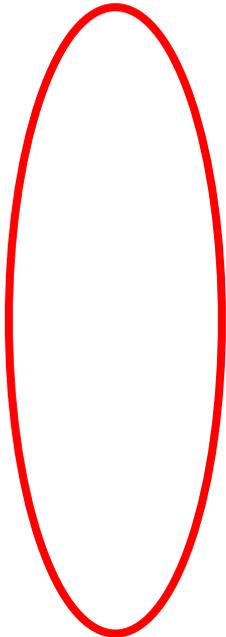
- Golf Biodynamics
- Kraftmessplatten
- 3D-Dopplerradar
- Ein Proband (HCP 0,5)

# Schräglage / Aufbau

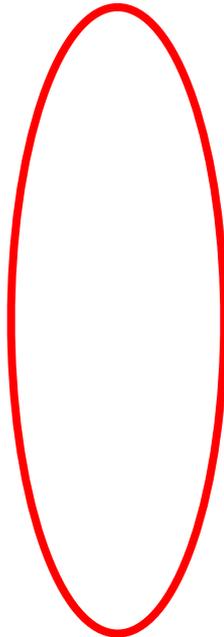


# Methode – Welche Zeitpunkte werden verglichen?

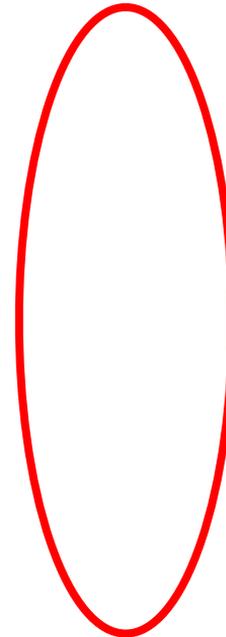
Address (**Add**)



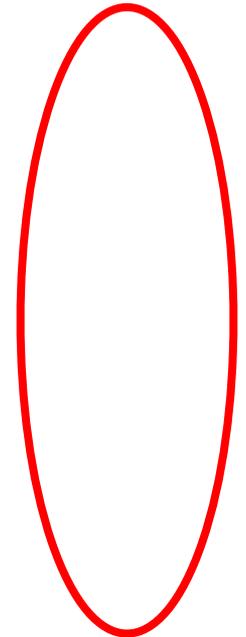
Top of Backswing(**ToB**)



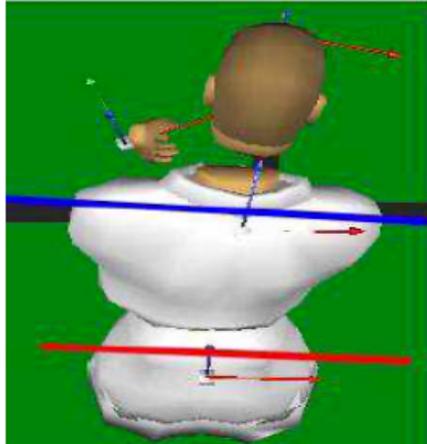
Impact (**Imp**)



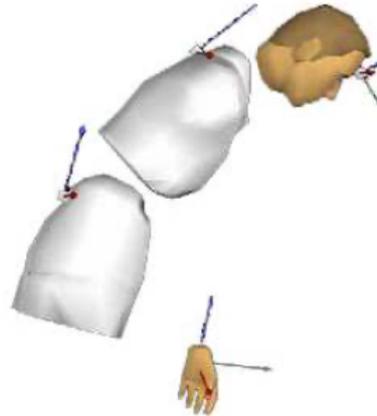
Finish (**Fin**)



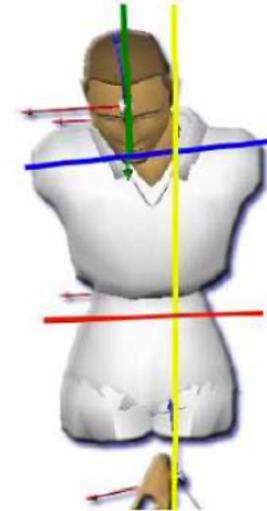
# Messparameter Golf Biodynamics



Rotation relativ zur Ziellinie

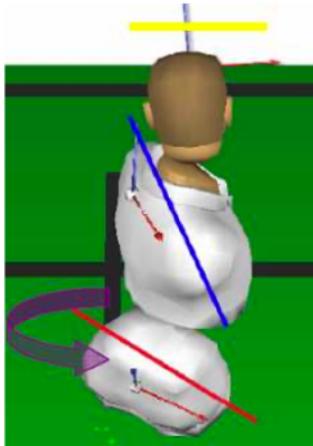


Neigung nach Vorne (Bend)  
Streckung nach Hinten



seitliches Verschieben (Sway)  
Kippen (Tilt)

# Messparameter Golf Biodynamics



Rotation /  
X-Factor

Body Speed		
	Corridor	You
Hips	$\geq 400$ deg/s	365
UT	$\geq 550$ deg/s	510
Arm	$\geq 780$ deg/s	647
Hand	$\geq 1300$ deg/s	1,323

Rotationsgeschwindigkeit  
von Körpersegmenten

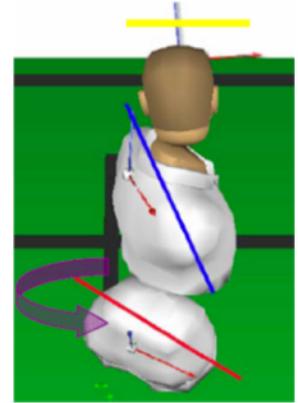
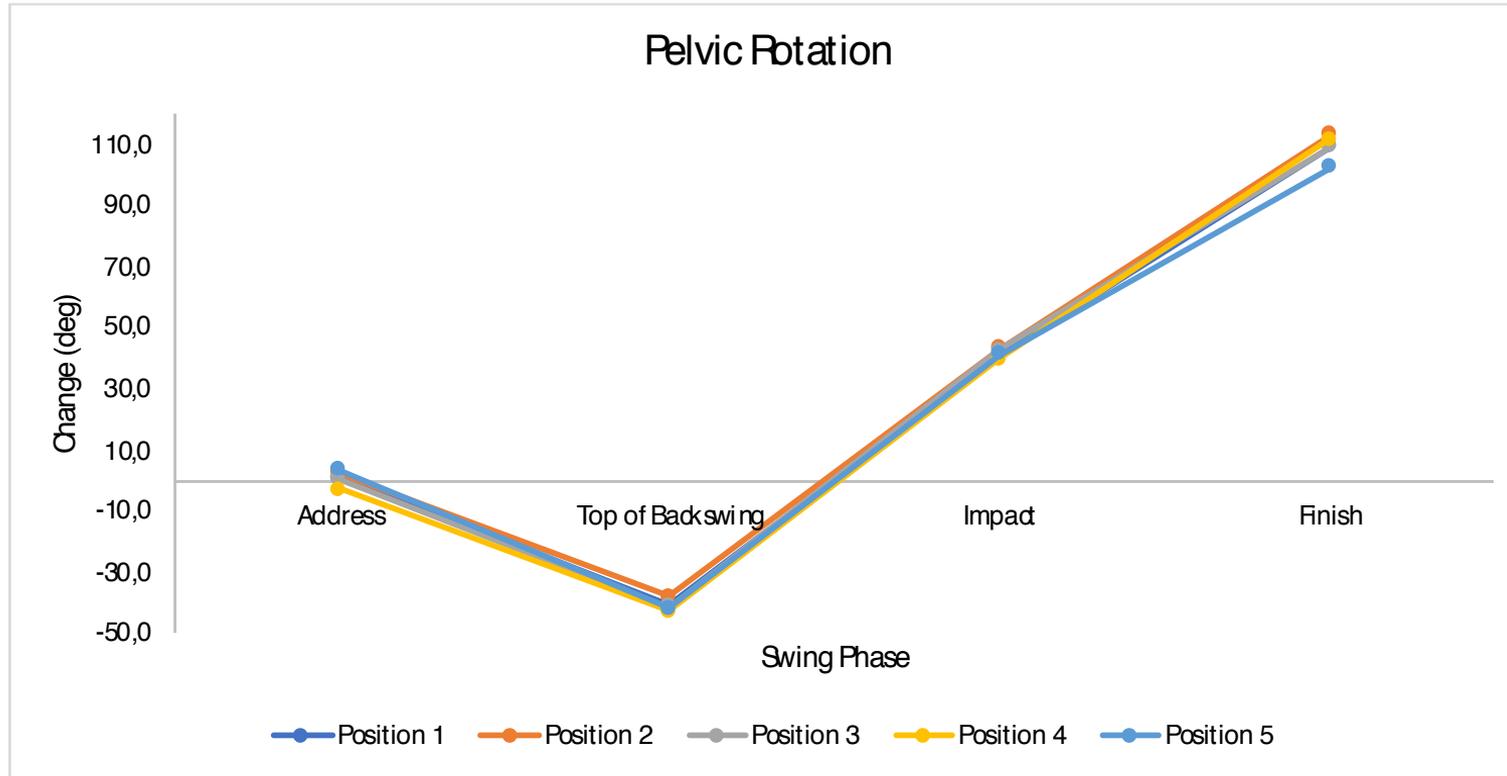
# Ergebnisse

# Ergebnisse des GBD:

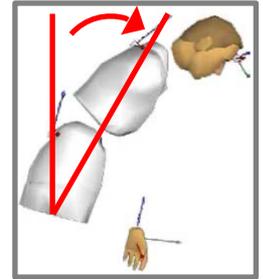
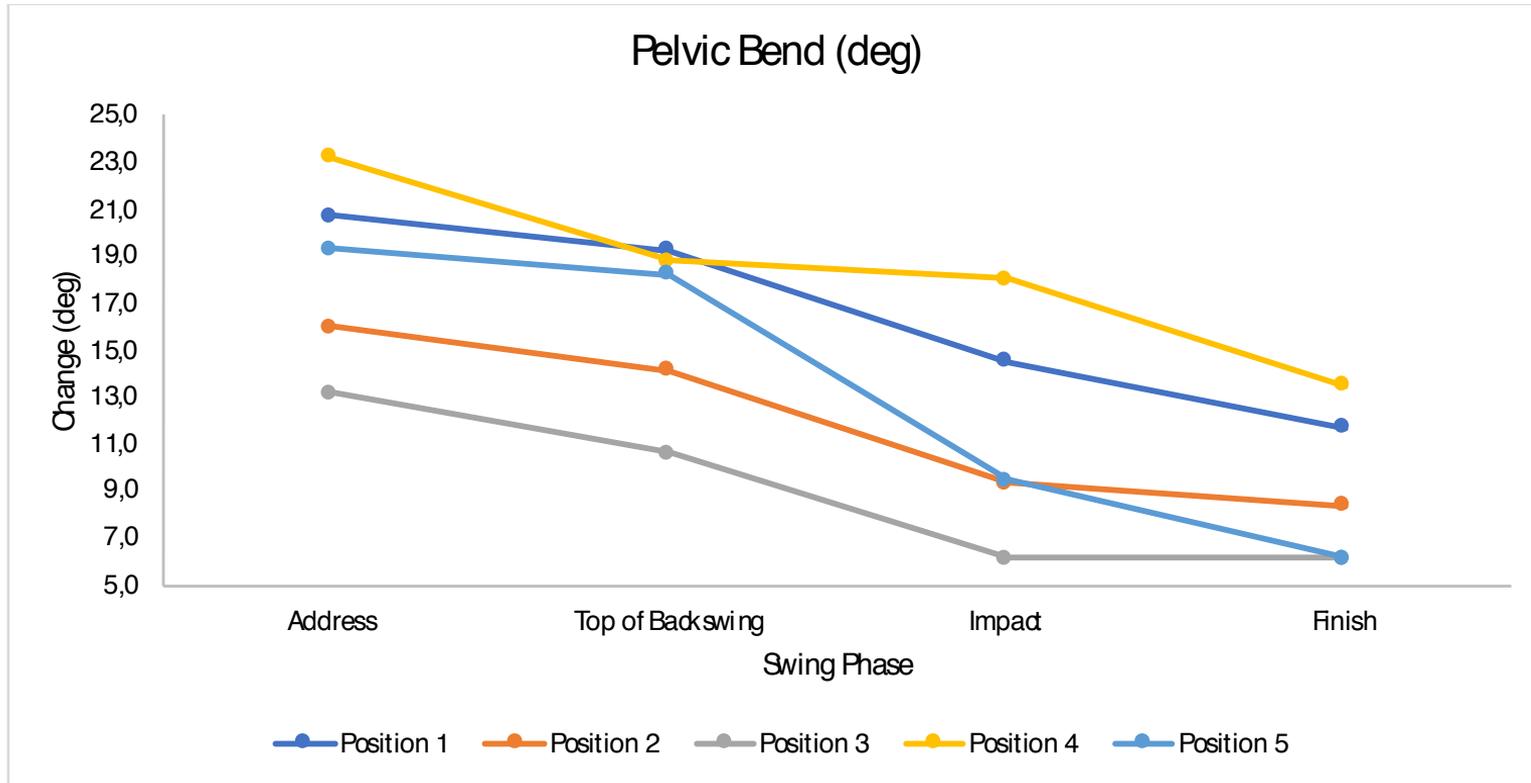
Prinzipiell 3 verschiedene Herangehensweisen:

1. Was passiert mit derselben Variable über einen kompletten Golfschwung
2. Was passiert zum gleichen Zeitpunkt in den verschiedenen Schräglagen
3. Wie liegen die gemessenen Werte im Vergleich zum Goldstandard (GBD-Wertekorridor aus 70 Tour-Spielern)

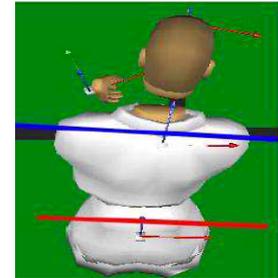
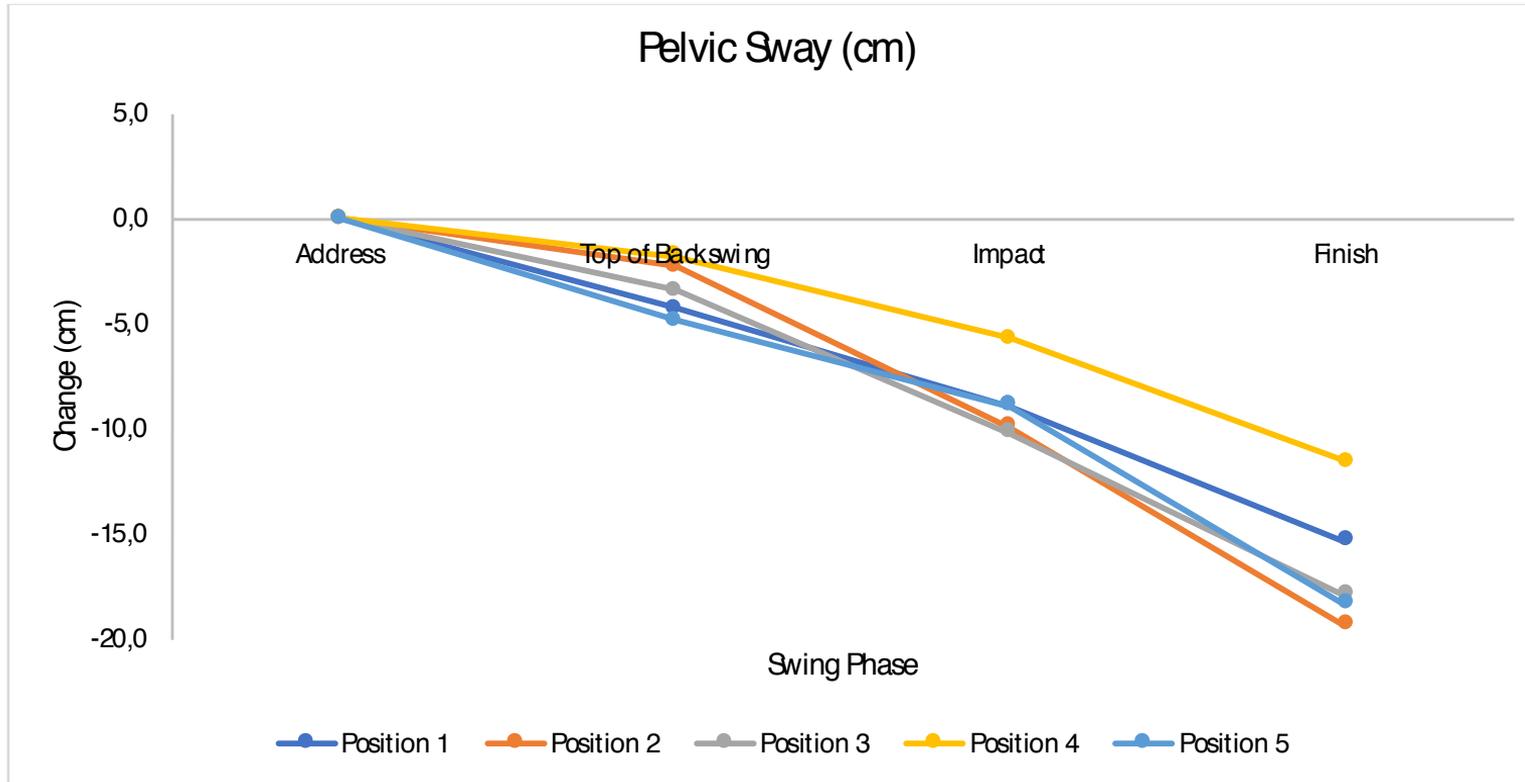
# 1. Gleiche Variable – Rotation Becken



# 1. Gleiche Variable – Neigung nach vorne



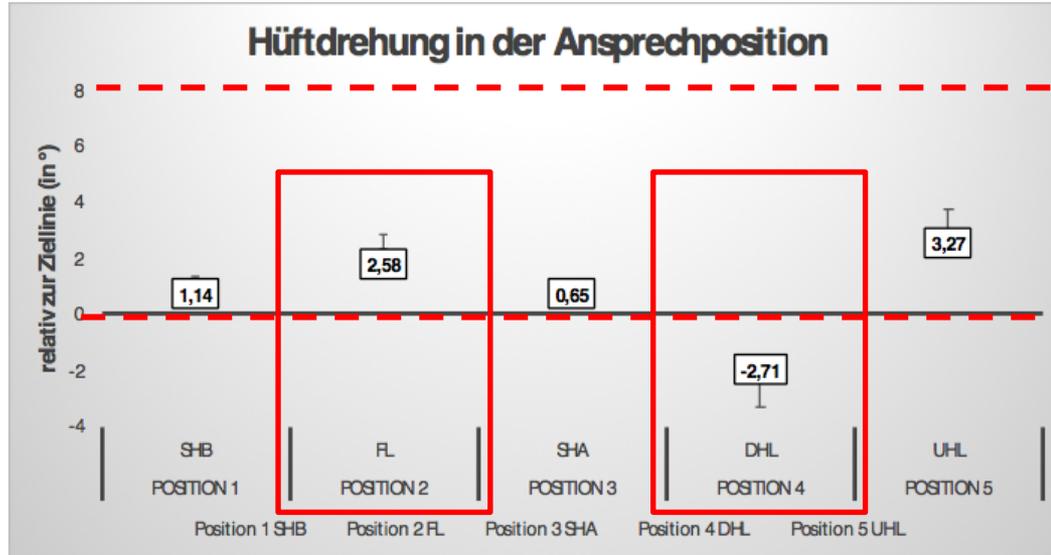
# 1. Gleiche Variable – seitl. Verschiebung



## 2. Gleicher Zeitpunkt – verschiedene Schräglage:

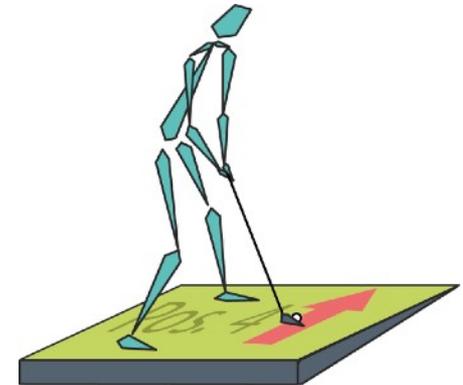
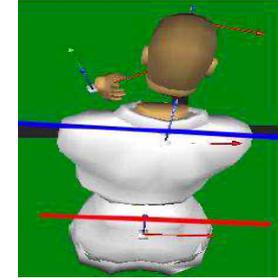
- Ausrichtung zum Ziel in Ansprechposition (Hüfte & Schulter)
  - Maximale Rotation (X-Factor und X-Factor Stretch)
  - Rotationsachse (Veränderung der Wirbelsäule)
  - Schwungdauer (Rückschwung und Durchschwung)
  - Schlägerkopfgeschwindigkeit
- 
- Korridor GBD: Durchschnitt von 70 Tourspielern

# Ausrichtung zum Ziel

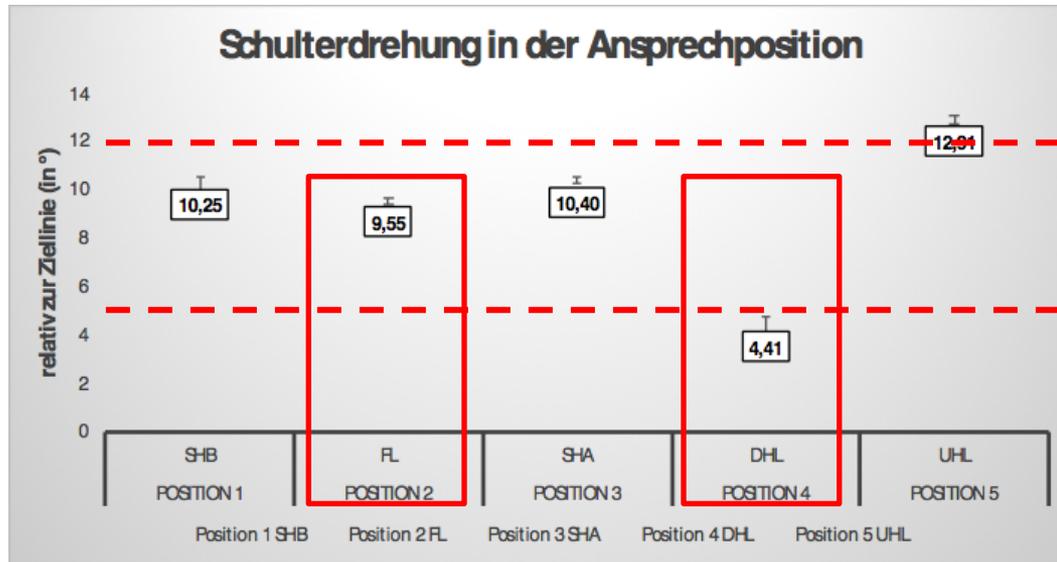


GBD:  
0°

8°

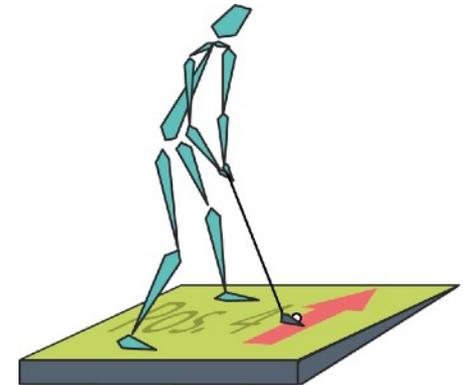
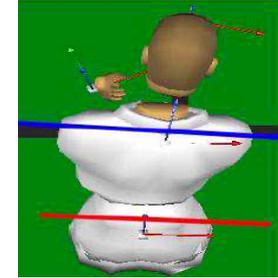


# Ausrichtung zum Ziel

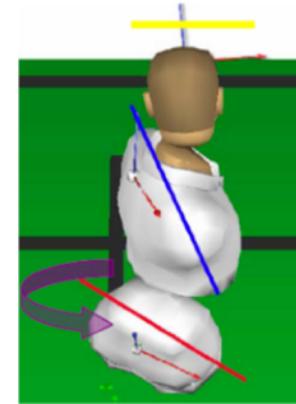
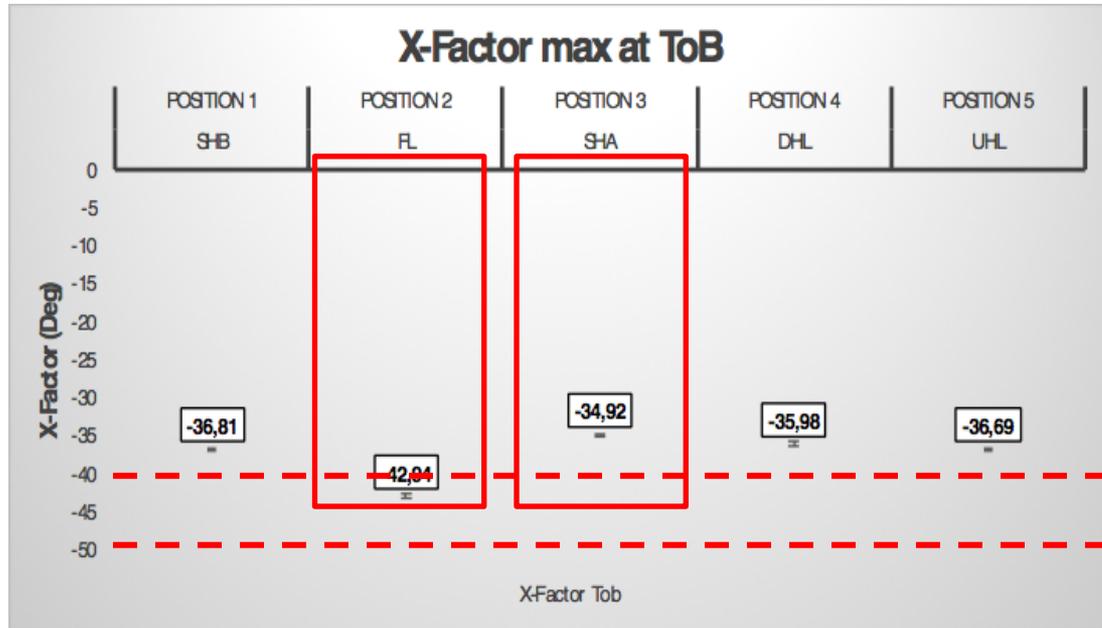


GBD:  
5°

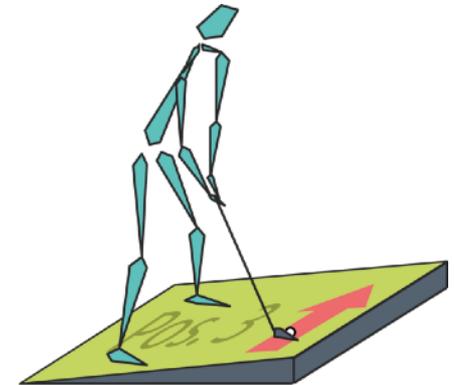
12°



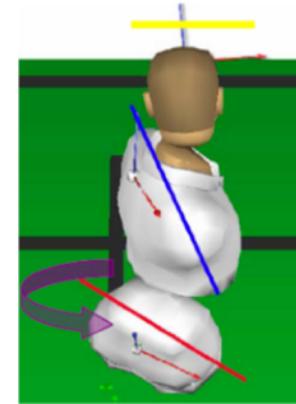
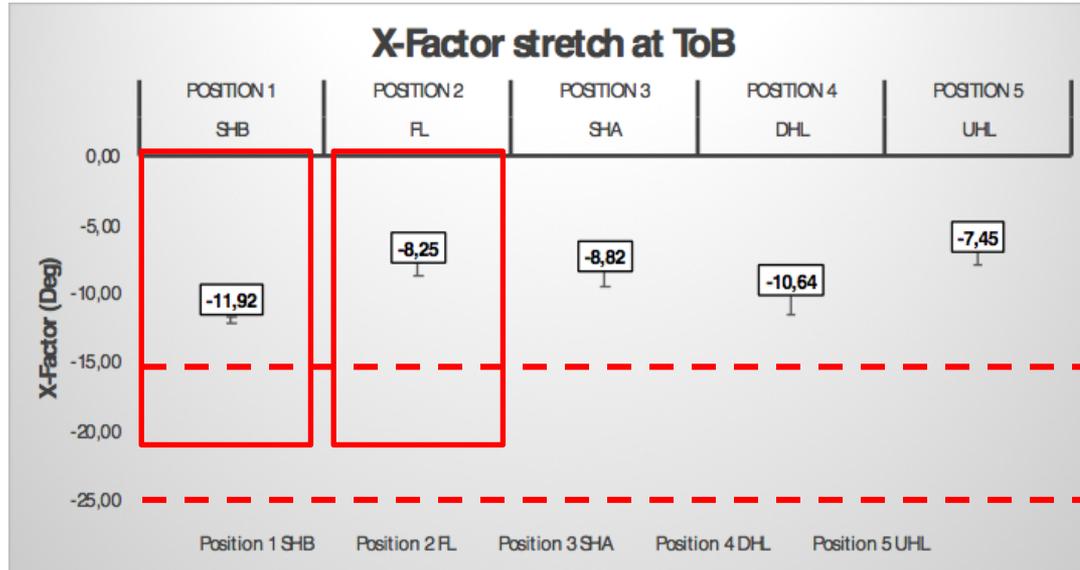
# X-Factor



GBD:  
-40°  
-50°



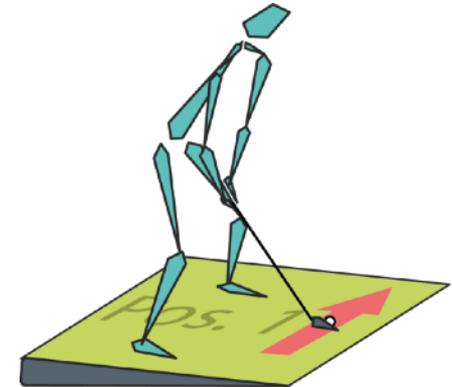
# X-Factor stretch



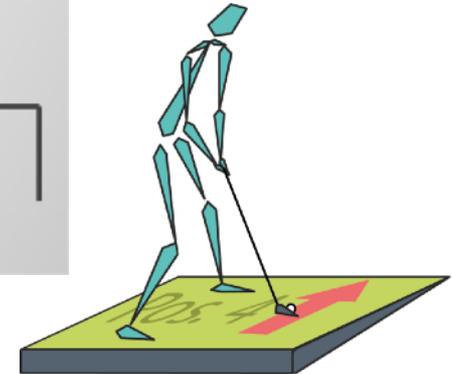
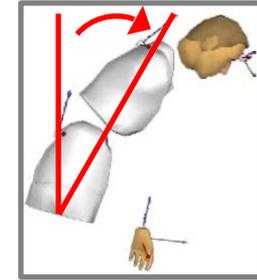
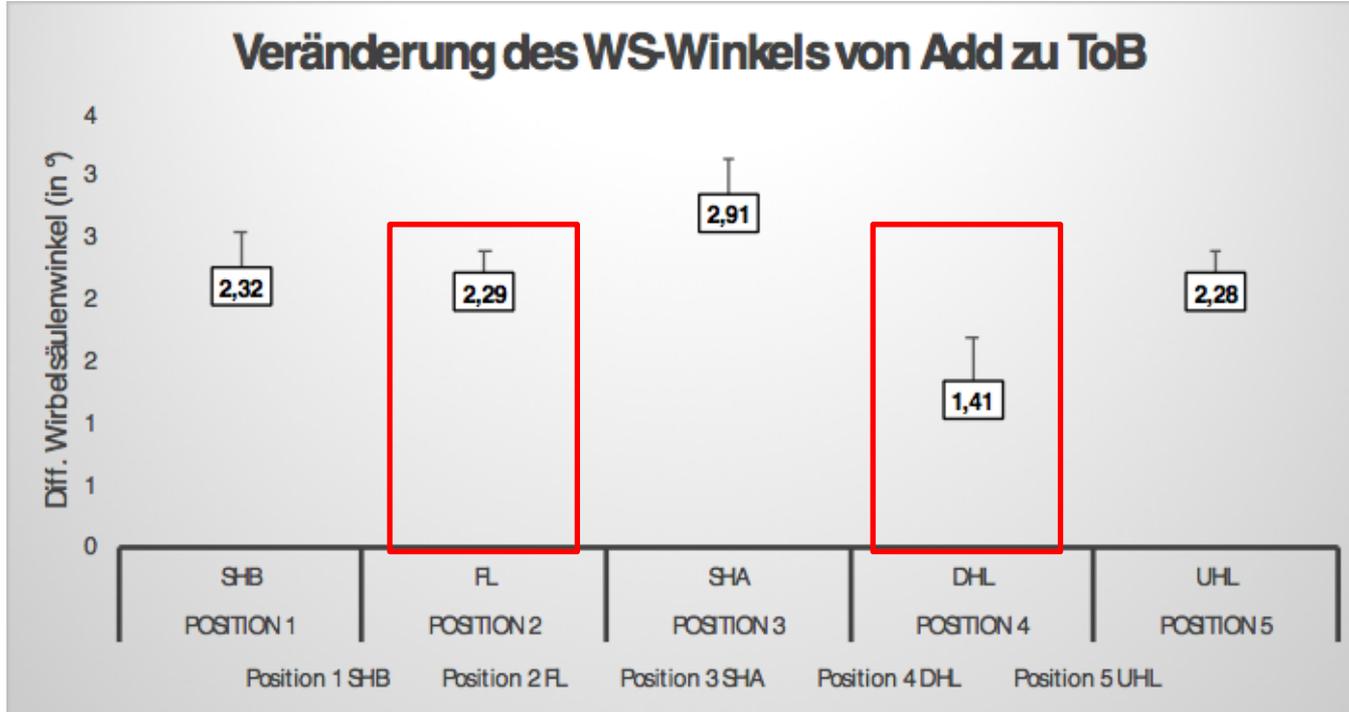
GBD:

-15°

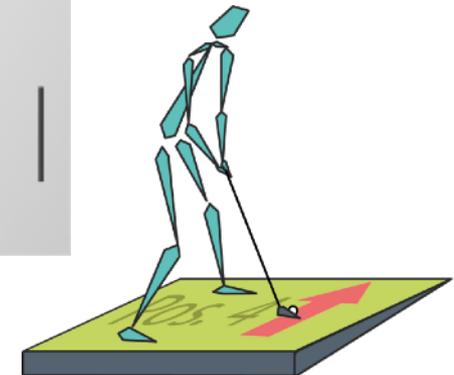
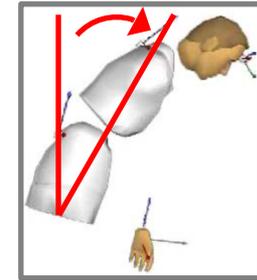
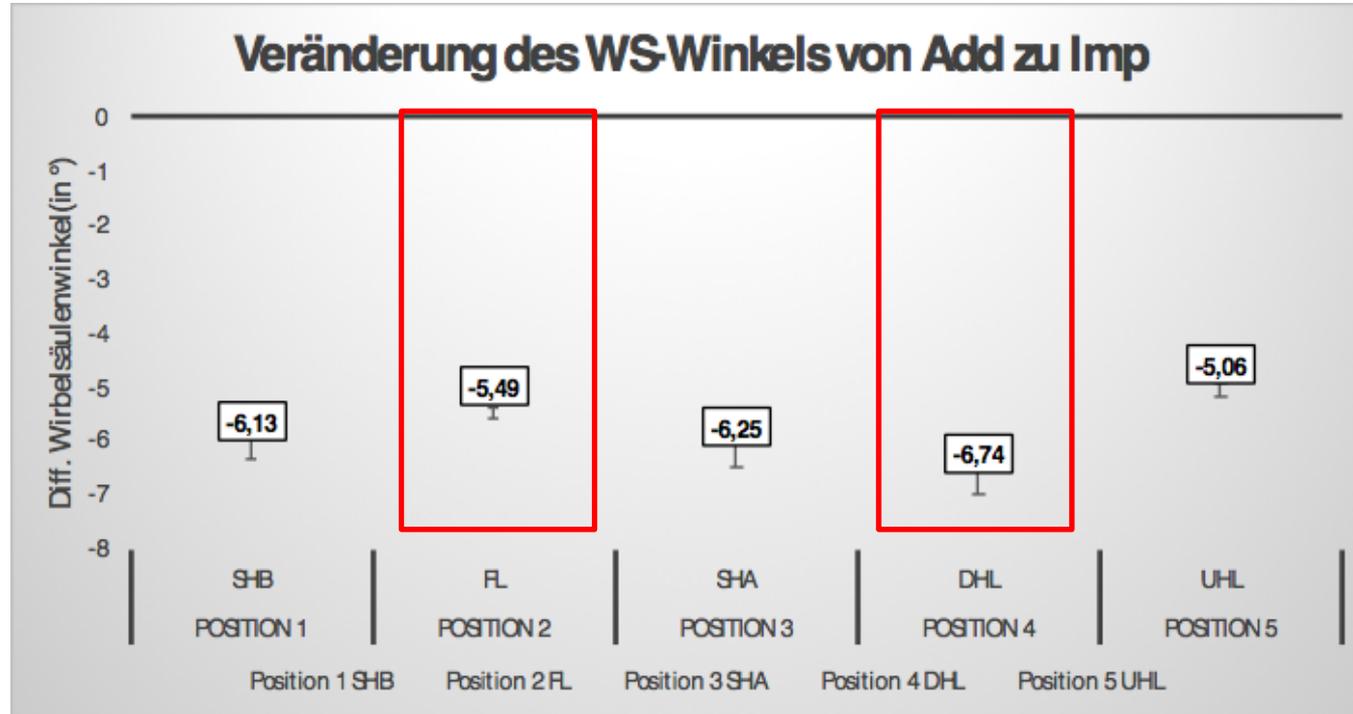
-25°



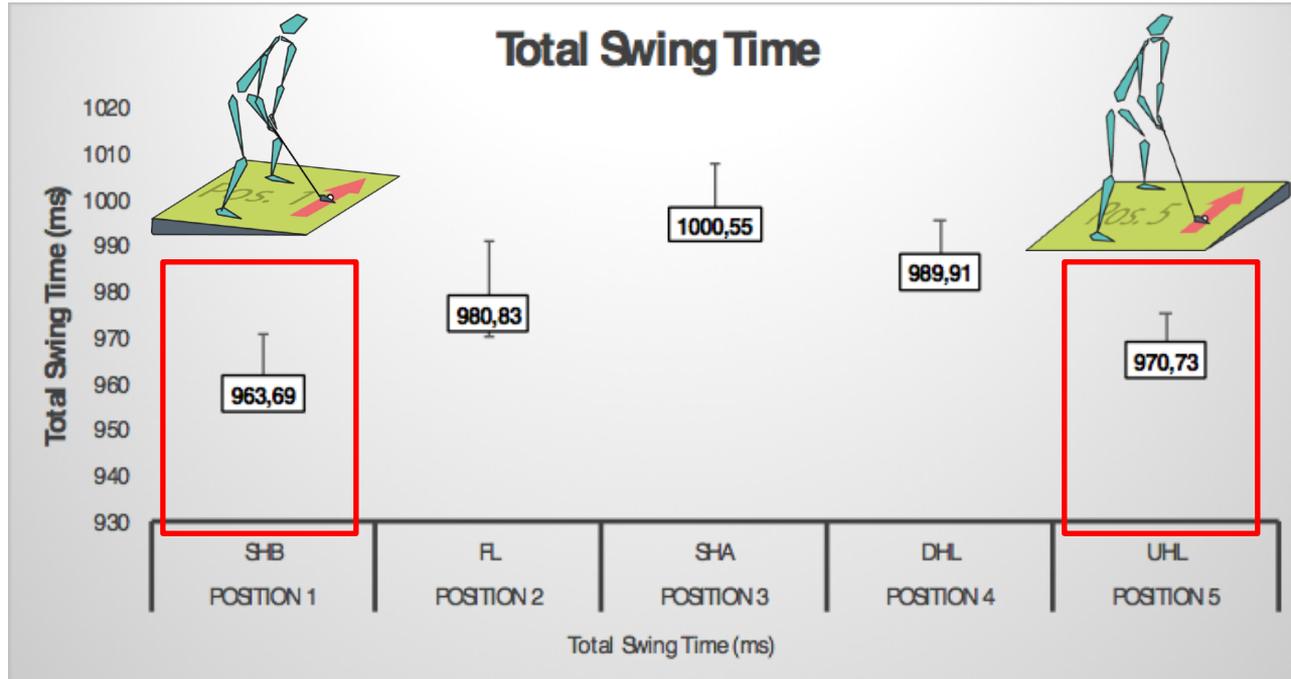
# Neigung der Wirbelsäule

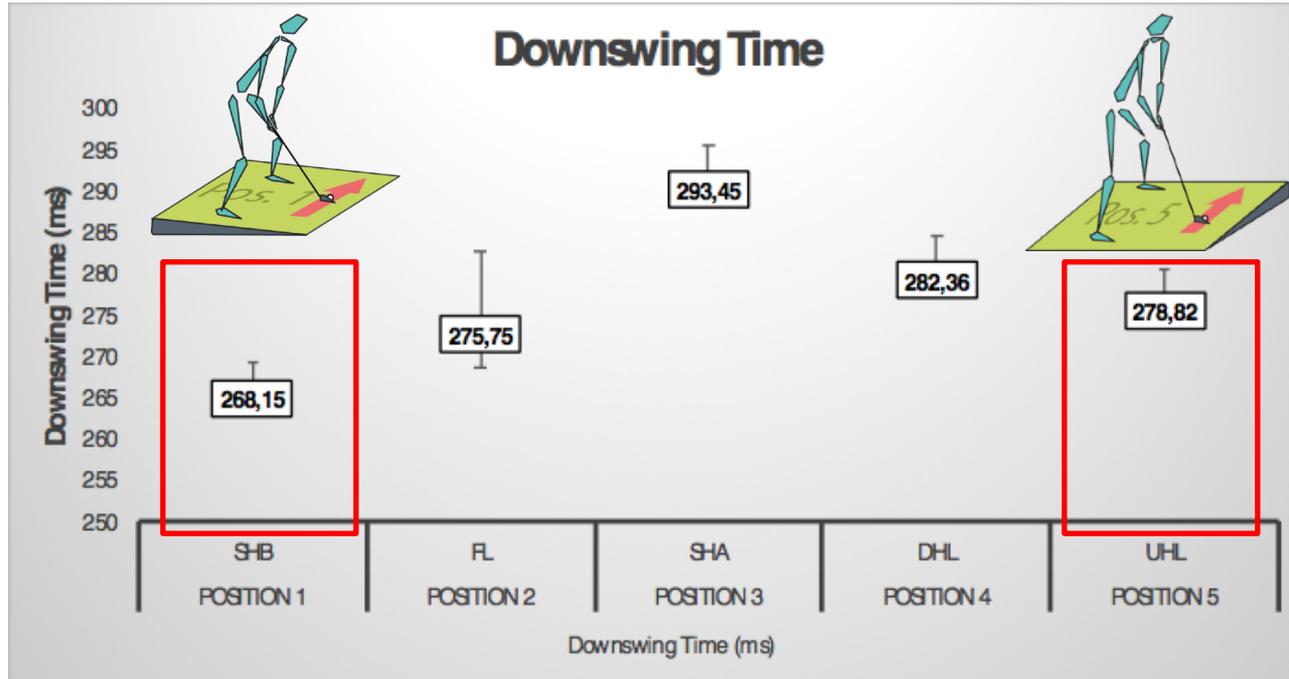


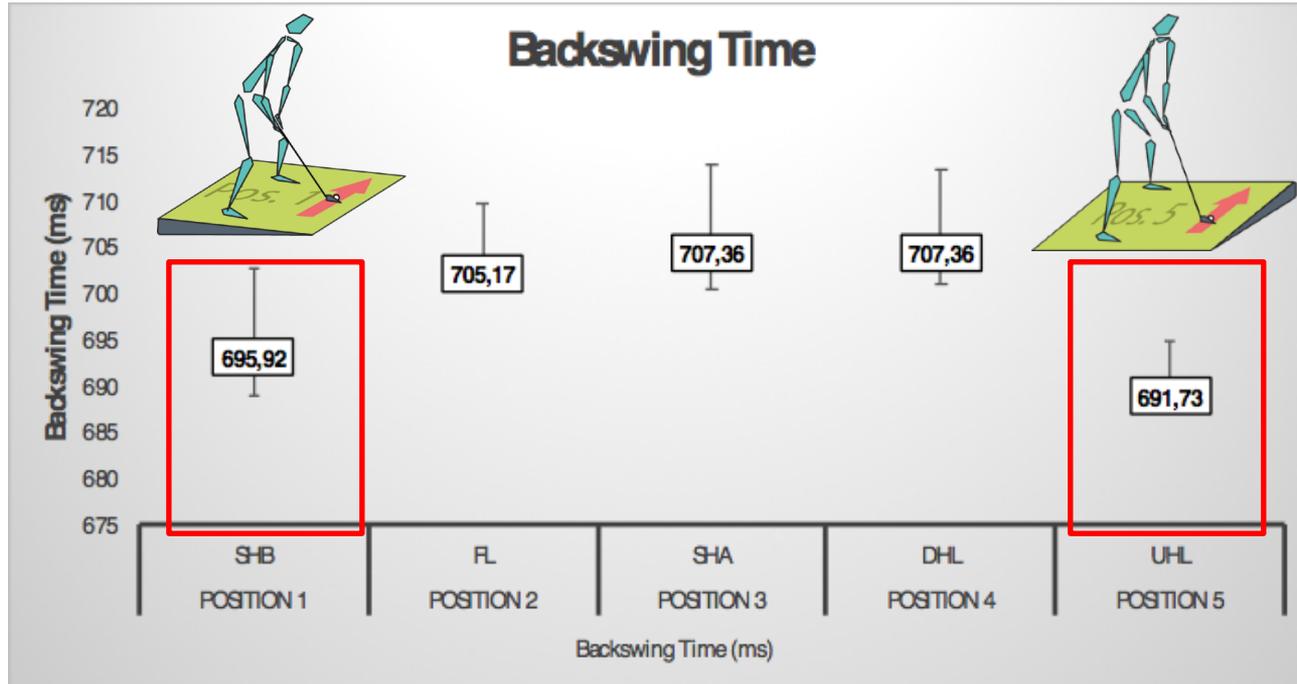
# Neigung der Wirbelsäule



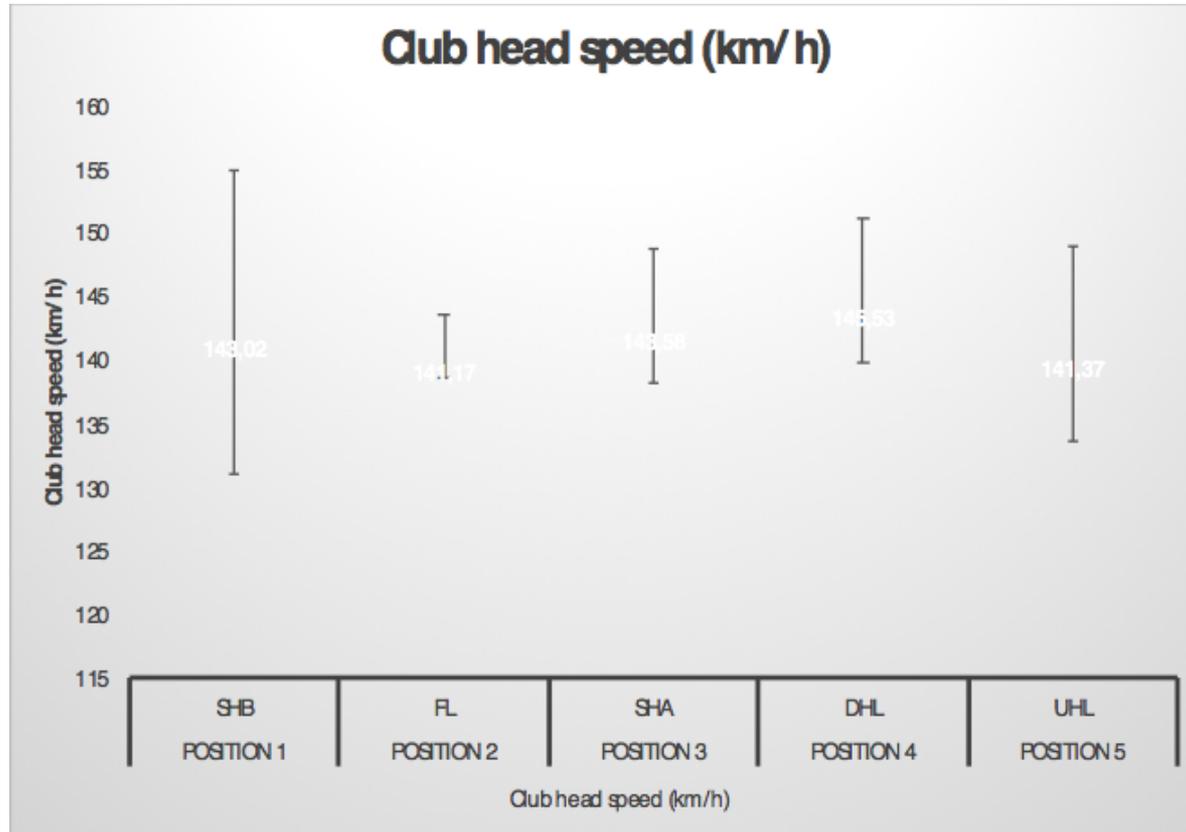
# Dauer Golfschwung







# Schlägerkopfgeschwindigkeit



# Diskussion

# Diskussion

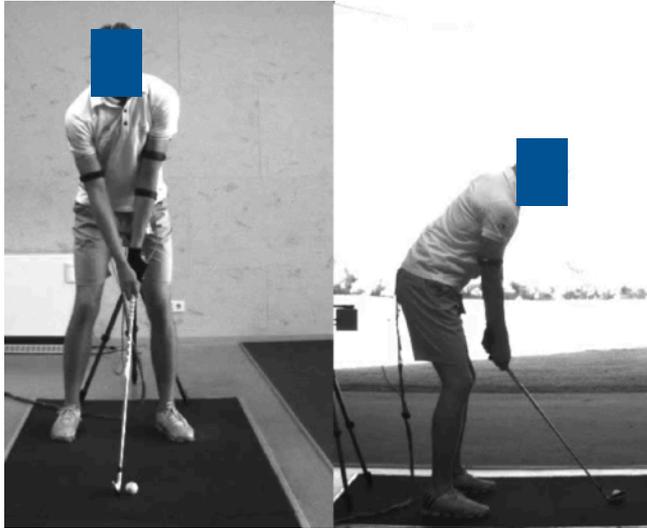
- Konstante Schlägerkopfgeschwindigkeit in allen Schräglagen (deckt sich mit anderer Studie)
- Unterschied bei Hüfte und Schultern in bestimmten Lagen  $\neq$  anders als bei Studie von Blenkinsop et al.
- Forschung mit größerer Stichprobe und festem Unterbau

# Human Pose Estimation

Masterarbeit von Sebastian Riegelbauer

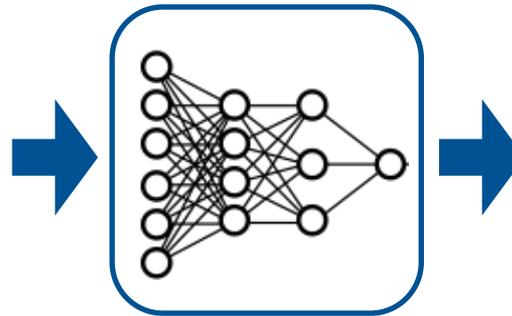
# Deep Pose Golf

Input Video

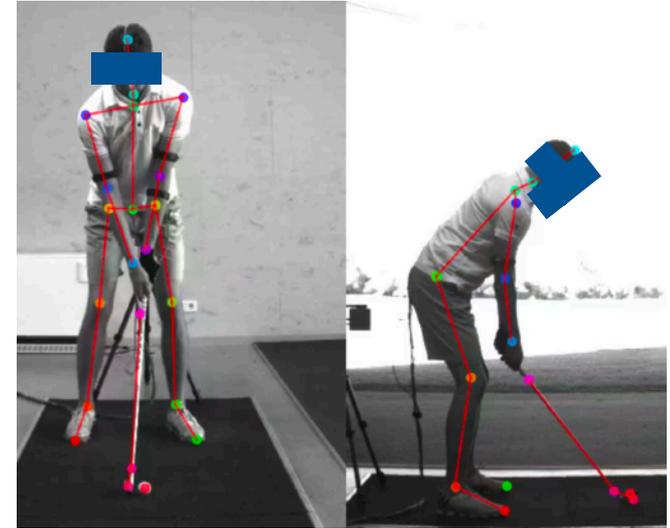


Machine Learning

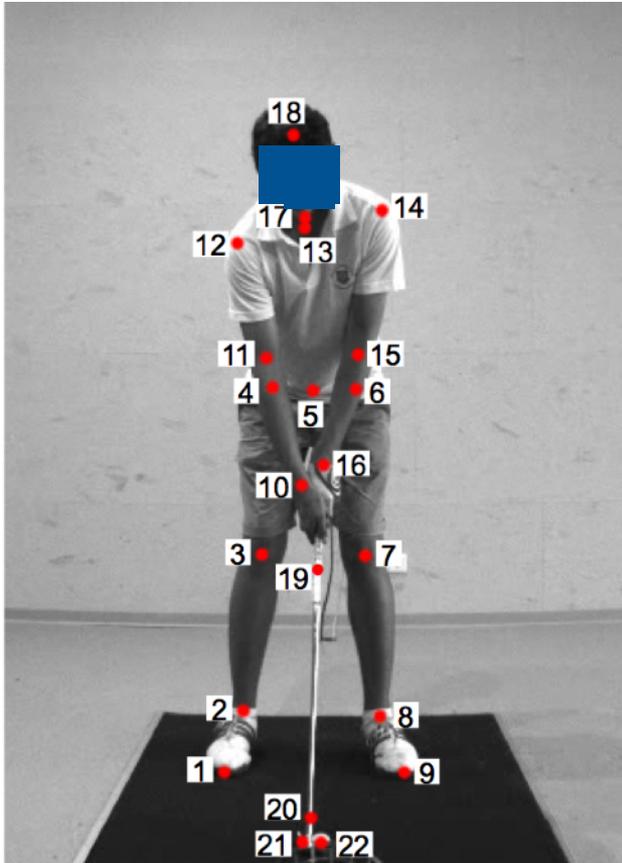
Model



Keypoints



# Body Annotations

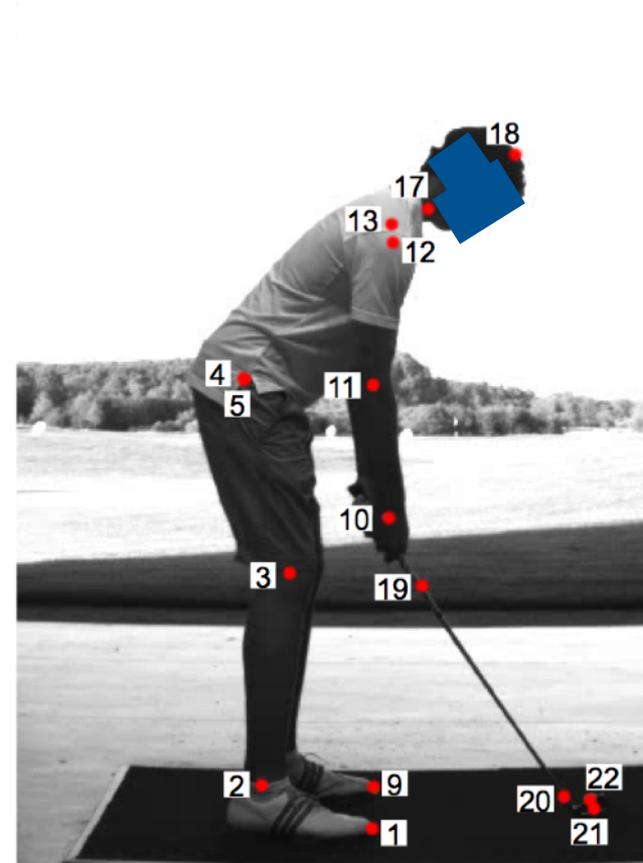


## BODY key points

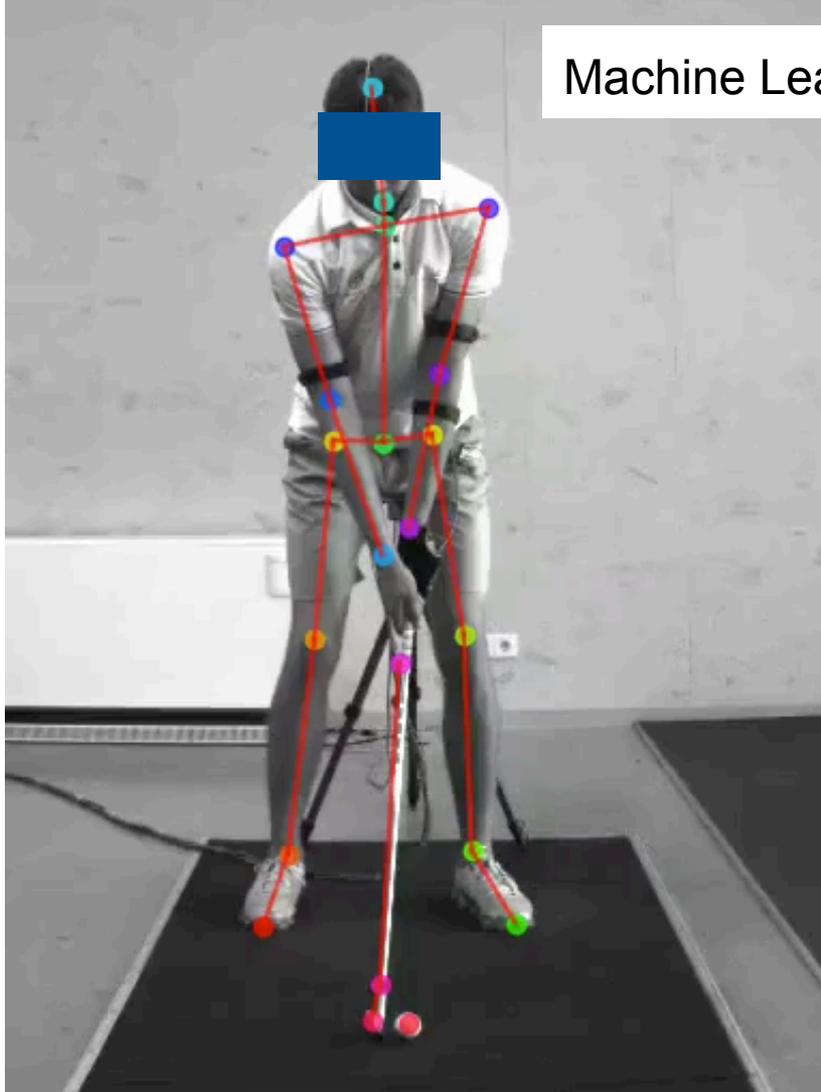
- (1) R Foot Tip
- (2) R Ankle
- (3) R Knee
- (4) R Hip
- (5) Pelvis
- (6) L Hip
- (7) L Knee
- (8) L Ankle
- (9) L Foot Tip
- (10) R Wrist
- (11) R Elbow
- (12) R Shoulder
- (13) Thorax
- (14) L Shoulder
- (15) L Elbow
- (16) L Wrist
- (17) Upper Neck
- (18) Head Top

## GOLFCLUB key points

- (19) Grip
- (20) Ferrule
- (21) Club Center
- (22) Ball



# Machine Learning Model



# Kombination

