UNIVERSITEIT GENT

KINEMATICS OF OVERGROUND ACCELERATED RUNNING

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INTRODUCTION...

Changing gait speed is a functional aspect of locomotion. In order to accelerate, fore-after ground reaction forces (GRF) of steady-state running are modified to form a net forward oriented force impulse (1). Kugler et al. (2) demonstrated that in order to generate this type of force and to maintain balance the body centre of mass moves (BCOM) less posterior of (or even in front of) the centre of force (COF) at initial contact and v.v. at toe off. The specific kinematics underlying this forward body lean have not been discussed. Therefore we document the segmental kinematics of accelerated running compared to steady state running.

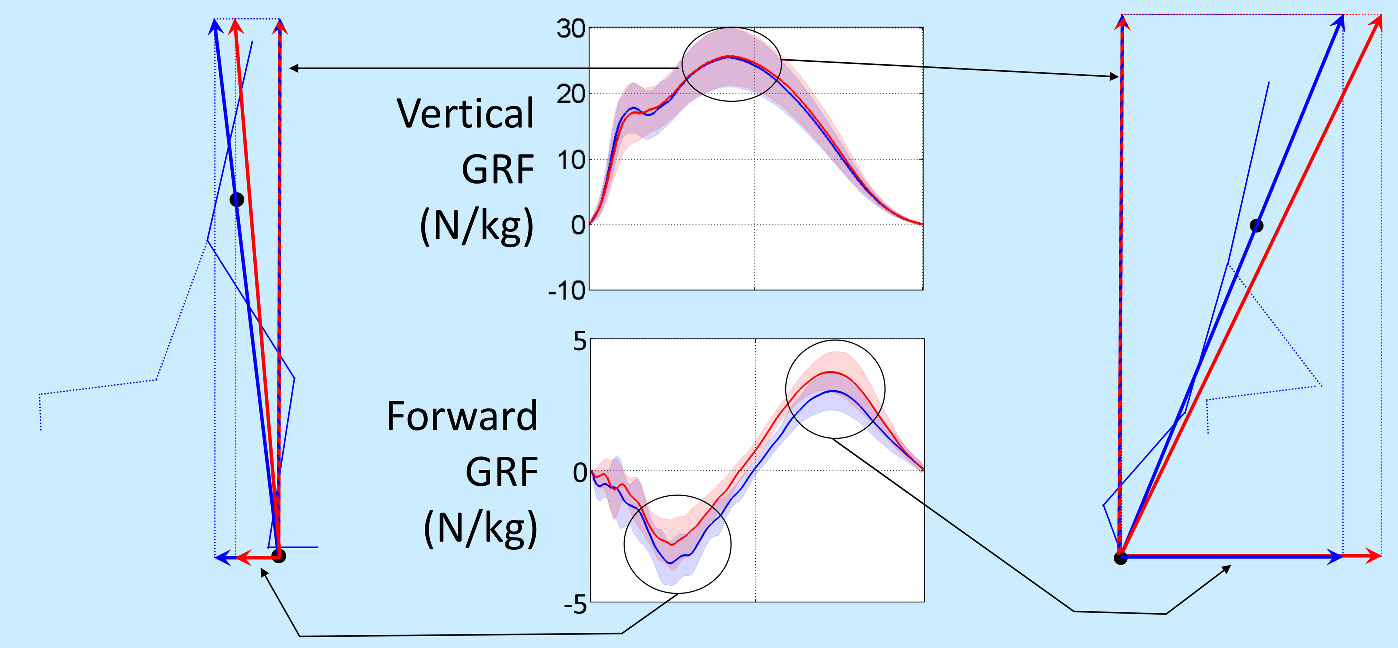


Figure 1: in order to accelerate the GRF-vector is oriented more forward, but should remain alligned with the BCOM to maintain balance.

METHODS...

13 healthy subjects: age: 26 ± 3 years - height: 1.72 ± 0.08 m - weight: 73 ± 9 kg

30m indoor instrumented runway
GRF and COF: 4 consecutive force platforms (0.5m AMTI, 1m AMTI, 0.6m KISTLER, 2m AMTI)
3D full-body kinematics (200Hz, 12-camera Qualisys Pro Reflex system); 12-segment kinematic model (using Visual3D, C-Motion)
Sagittal segment and joint angles: time-normalized to stance duration

Statistics: paired samples t-tests every 10% of stance ($p<0.05$)

Per subject >3 trials of:

steady state running
(0.01 ± 0.01 m/s^2, 3.41 ± 0.60 m/s)
moderately accelerated running
(0.55 ± 0.04 m/s^2, 3.89 ± 0.54 m/s)

RESULTS & DISCUSSION...

Figure 2: hypotheses (white arrows) and real kinematic adaptations (red arrows) to the steady state running pattern to accelerating

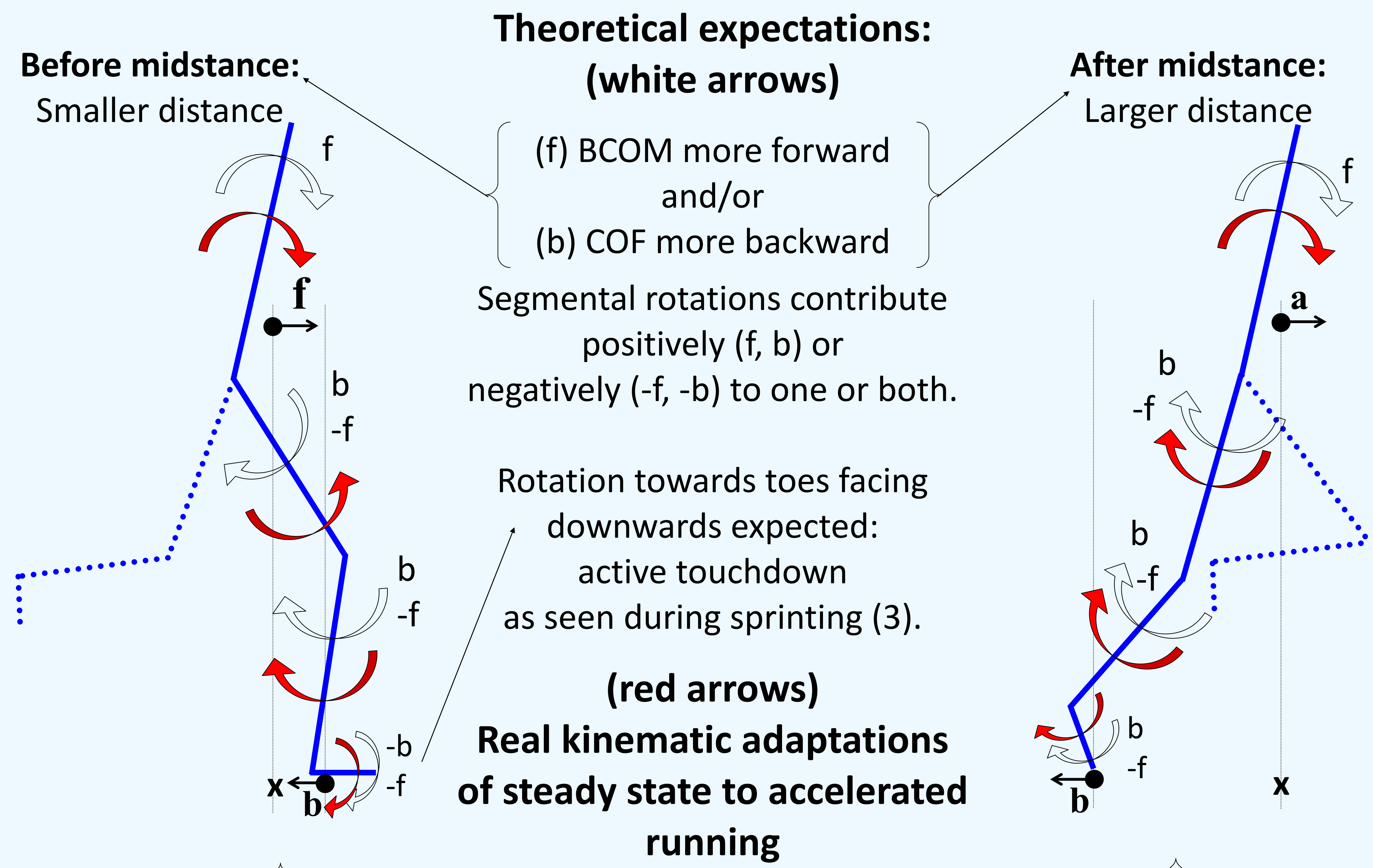
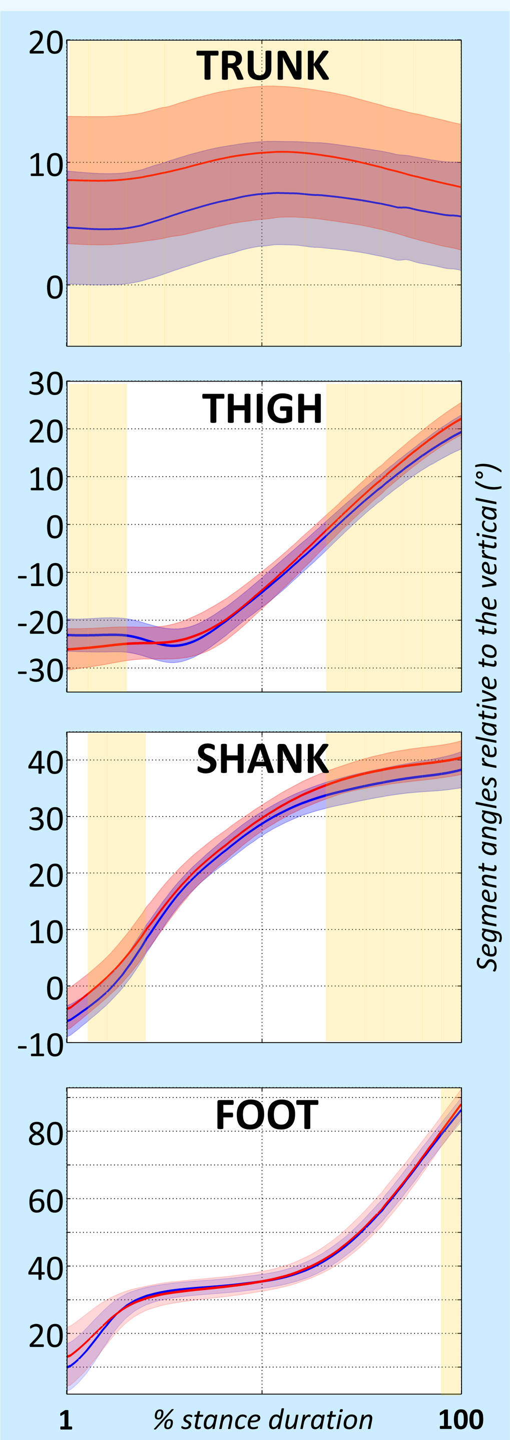


Figure 3: segment angles (°) of steady state vs. accelerated running. Yellow shade => p<0.05



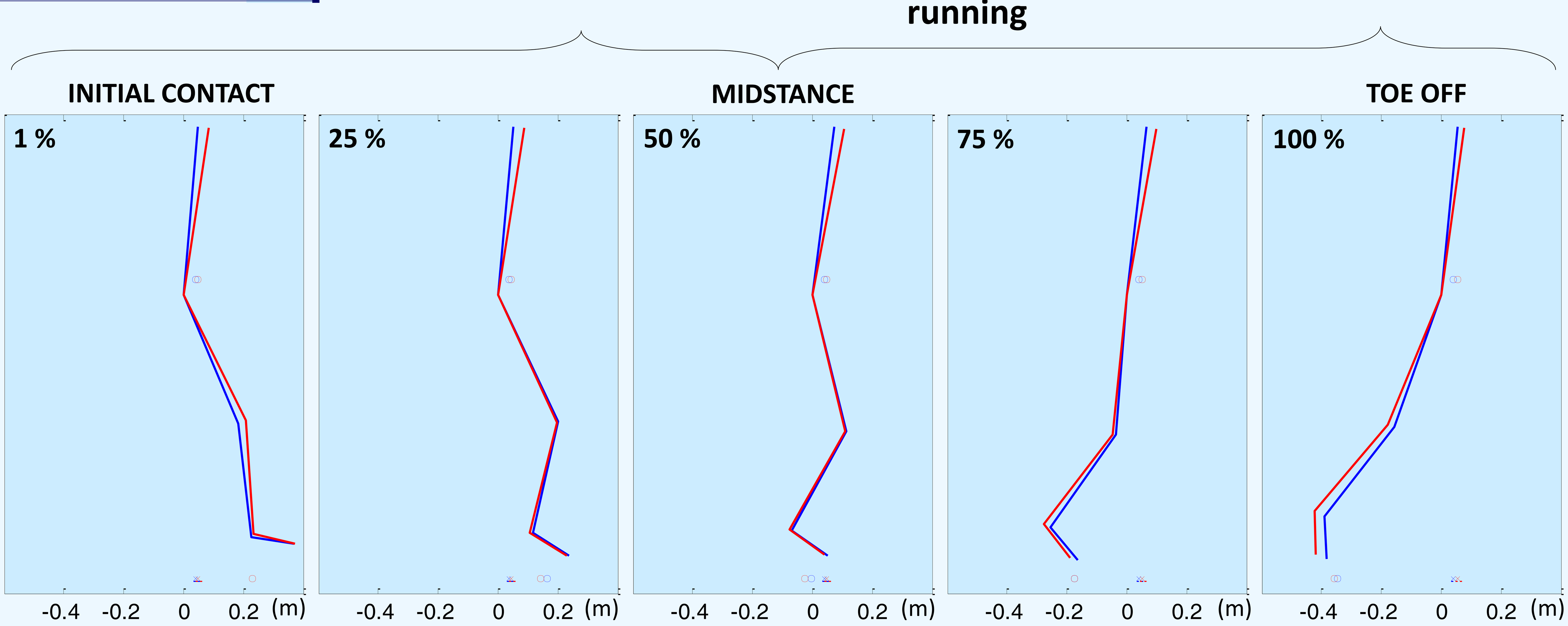


Figure 4: stick figures representing actual kinematics of steady state and accelerated running at 1, 25, 50, 75 and 100% of stance duration. x = vertical projection of the BCOM. o = vertical projection of the COF.

CONCLUSIONS...

In order to accelerate adaptations are made to the steady state trunk, thigh, shank and foot angle to make the distance between body centre of mass and centre of force smaller before midstance and enlarge this distance after midstance. This all contributes to a more forward body lean during accelerations.

REFERENCES & ACKNOWLEDGEMENTS

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