The influence of ankle VS hip powering on gait robustness and economy

Jian Jin[1], Dinant Kistemaker[1], Jaap van Dieën[1], Andreas Daffertshofer[1,2], Sjoerd M. Bruijn[1,2,3]

[1]Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam and Amsterdam Movement Sciences, Amsterdam, The Netherlands.

[2]Institute of Brain and Behavior Amsterdam

[3]Orthopaedic Biomechanics Laboratory, Fujian Medical University, Quanzhou, Fujian, PR China

E-mail: j.jin@vu.nl

Abstract

Gait in elderly humans is characterized by decreased ankle push-off power and increased hip power, which is accompanied by an overall increase in metabolic cost. One hypothesis on the mechanisms underlying this phenomenon is that older adults prioritize gait robustness over gait economy. Previous studies suggested that older adults are at higher risk of falling, and rely more on hip than ankle powering, which appears safer and more robust [1], while others found in young adults that diminished push-off contributes to poorer dynamic stability as quantified by the short-term maximum Lyapunov exponent [2]. To further explore the effects of hip versus ankle powering on robustness and economy, we use a planar walker model with both passive elasticity and active torques at hip and ankle. The model can generate gaits powered by the hip and/or the ankle and serves to investigate effects on both the "mechanical cost" of transport (calculated as the positive work produced by the hip and/or ankle) and gait robustness of the walker. The latter is quantified by the largest floor height the walker can handle without falling. To understand the influence of series elasticity at hip and ankle on energetic cost and robustness, we systematically varied the spring stiffness of the ankle and hip actuators. We are currently conducting all the corresponding numerical simulations and will present their outcomes at the conference. We believe that these results will shed new light on the robustness compensation hypothesis in the elderly. They will certainly clarify whether the strategy of shifting ankle powering to hip powering improves robustness, or that it is merely a compensatory response to other biological factors like loss of strength.

REFERENCES

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