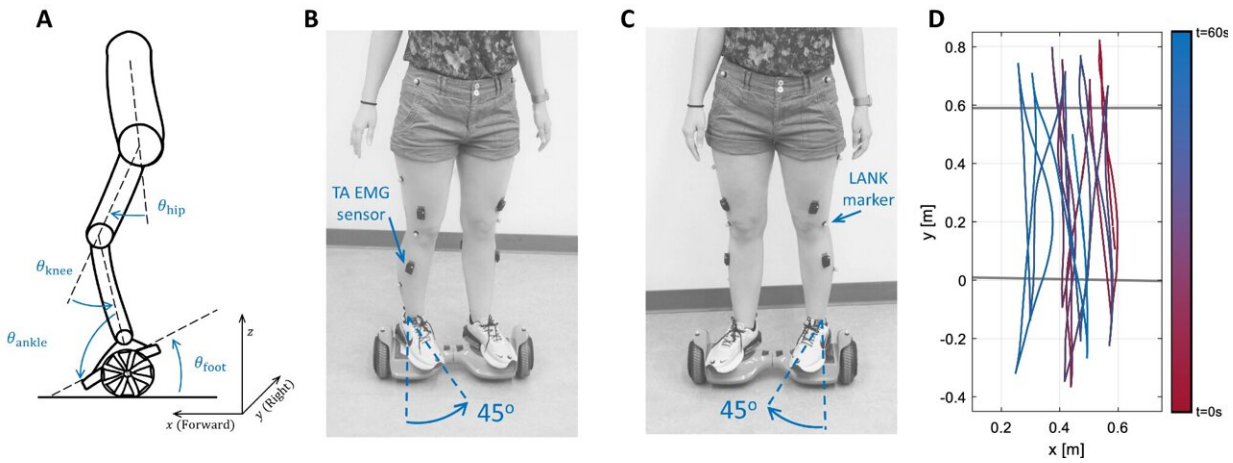
Researchers reveal tip for riders of hoverboards

August 8 2022



(A) Schematic of the joint angles and the hoverboard plate orientation (side view). (B) The feet are oriented 45∘∘ to the left of the hoverboard, corresponding to conditions A1 and A2. (C) Feet orientation in condition B. (D) Movement trajectory in the x-y plane from a representative participant #9 in condition A2. The line color (from red to blue) indicates the time. Grey lines indicate the goal lines participants had to cross. Credit: *Scientific Reports* (2022). DOI: 10.1038/s41598-022-08291-0

Engineering researchers have some simple advice for people learning to ride hoverboards: it's all in the ankles.

An experiment using sophisticated cameras and sensors attached to first-time riders revealed that ankle movements, not knee or hip movements,

are the key to catching on to the increasingly popular devices.

"Those who learned faster and performed better had strongly adopted an ankle strategy, meaning that they controlled their ankle motion by activating or co-activating the muscles around them," said Arash Arami, a professor of mechanical and mechatronics engineering at the University of Waterloo and senior author of a new study.

Hoverboards have a motor and two wheels connected by a platform. Riders steer and balance with their feet, although some models are self-balancing.

While new riders would be wise to concentrate on ankle movement, the study by researchers in Canada, the United Kingdom and Japan also showed the central nervous system somehow seems to just know the best strategy to use.

After a short familiarization session, volunteers were primarily relying on ankle movements within a few minutes of maneuvering hoverboards back and forth using three different foot positions.

"The process of learning how to ride a hoverboard is largely subconscious," Arami said. "Interestingly enough, our central nervous system can usually figure it out without much instruction, so take it easy and enjoy the ride."

Researchers theorize ankle movement is primarily used to learn to ride because they're the joints closest to the board, primates generally learn better with their hands and feet, and the central nervous system often tries to minimize muscular effort.

The researchers used hoverboards as a tool to investigate how the central nervous system, including the neural networks in the brain and spinal

cord, controls human movement.

The results have implications for the design of platforms for balance training for older adults at risk of falls and stroke survivors in rehabilitation clinics. They could also help with the design of hoverboards and similar devices, such as snowboards.

Researchers are ultimately interested in using technology to develop assistive and rehabilitative robotics systems to allow people with impairments to regain movement.

"Hoverboards, as simple as they appear, help us dig into how we control our lower limbs and deepen our understanding of human motor control," Arami said.

Arami and Mohammad Shushtari, lead author and a Ph.D. candidate at Waterloo, collaborated with engineers at NTT Communication Science Laboratories in Japan and the Imperial College of Science, Technology and Medicine in the UK.

A paper about their work, "Balance strategy in hoverboard control," appears in the journal *Scientific Reports.*

More information: Mohammad Shushtari et al, Balance strategy in hoverboard control, *Scientific Reports* (2022). DOI: 10.1038/s41598-022-08291-0

Provided by University of Waterloo