



The Treadmill Effect: The Alteration of Gait Parameters Following Treadmill Activity

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Abstract

The pattern in which an individual walks is defined as his or her gait. Gait is specific to an individual, and basic gait parameters, including step velocity, step frequency, and step length can be established. Additionally, center-of-mass motion is also specific to an individual and can be calculated through motion analysis. In these experiments, video analysis was used to establish an individual's basic gait parameters and center-of-mass oscillation. These parameters were then used as a standard to investigate the sensation of vertigo, known as the "treadmill effect," immediately following treadmill activity. Results show that treadmill activity does produce an alteration in step length and parameter variability.

Background

Gait is specific to an individual, and the gait cycle, the continuous action of walking or running, can be broken down into two main phases: stance and swing. The stance phase, the period during which the foot is in contact with the ground surface, is approximately 60% of the gait cycle while the swing phase, during which the foot is in motion, equates the remaining 40%.

Through motion analysis of these two phases, basic gait parameters can be established. The parameters most commonly used include velocity (V), step frequency (SF), and step length (SL); where, over distance D, time T, and number of steps (N):

$$\text{Velocity : } V = D/T$$

$$\text{Step Frequency : } SF = N/T$$

$$\text{Step Length : } SL = V/T$$

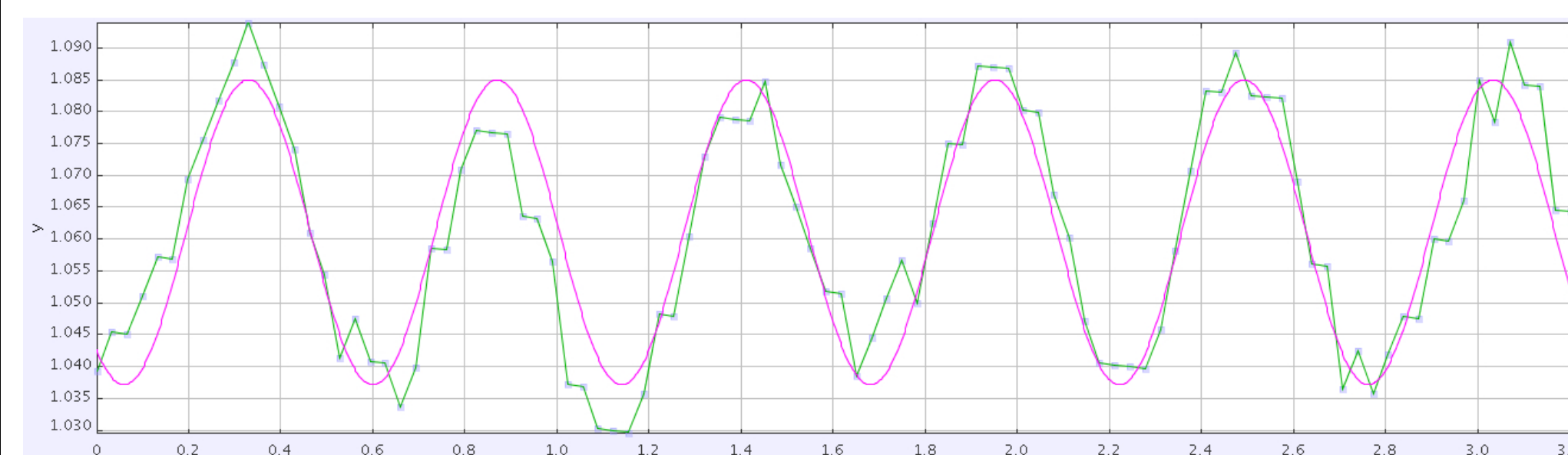
Background Continued

During the gait cycle, the center of mass of the body rises and falls in a sinusoidal motion. This motion curve can also be established through motion analysis with a curve fit $y = A\sin(Bt+C)+D$. Comparison with the sinusoidal function $y = A\sin(\omega t + \theta)$ shows that the center-of-mass oscillation amplitude (CM amp.) is coefficient A.

Currently, no literature exists on the impact of treadmill activity on an individual's gait and center-of-mass motion and if this impact, if any, is a factor in producing the "treadmill effect."

Procedure

In this experiment, high-speed video (VN = number of videos) was used to film an individual walking and to track her motion. Using Tracker software, basic gait parameters were established, and the center-of-mass motion was measured by fitting a sinusoidal function to the graph of vertical position as a function of time (Experiment 1). These established parameters and center-of-mass motion were then used as a standard to evaluate the impact of treadmill activity on gait and center-of-mass motion (Experiment 2).



Results Experiment 1

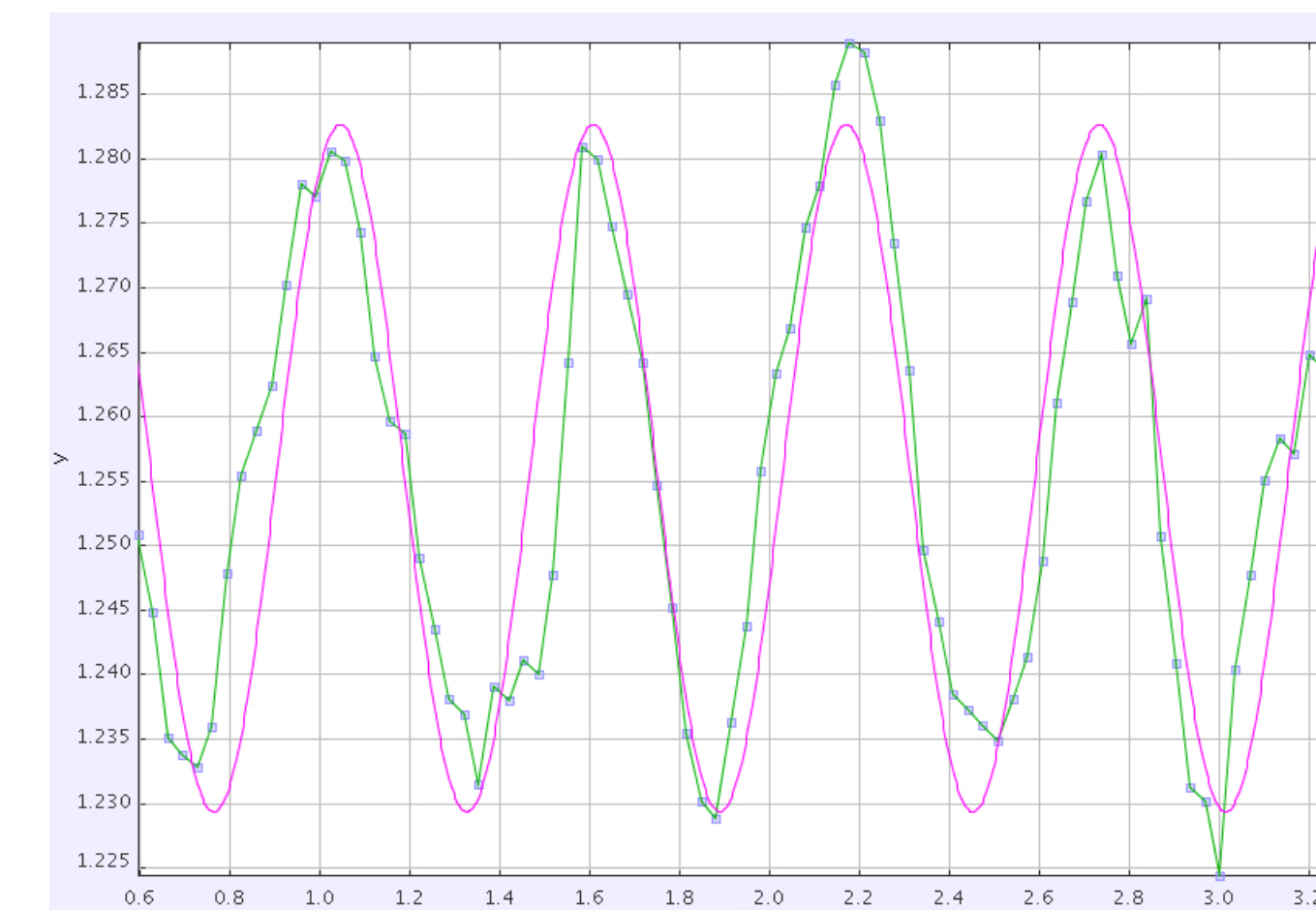
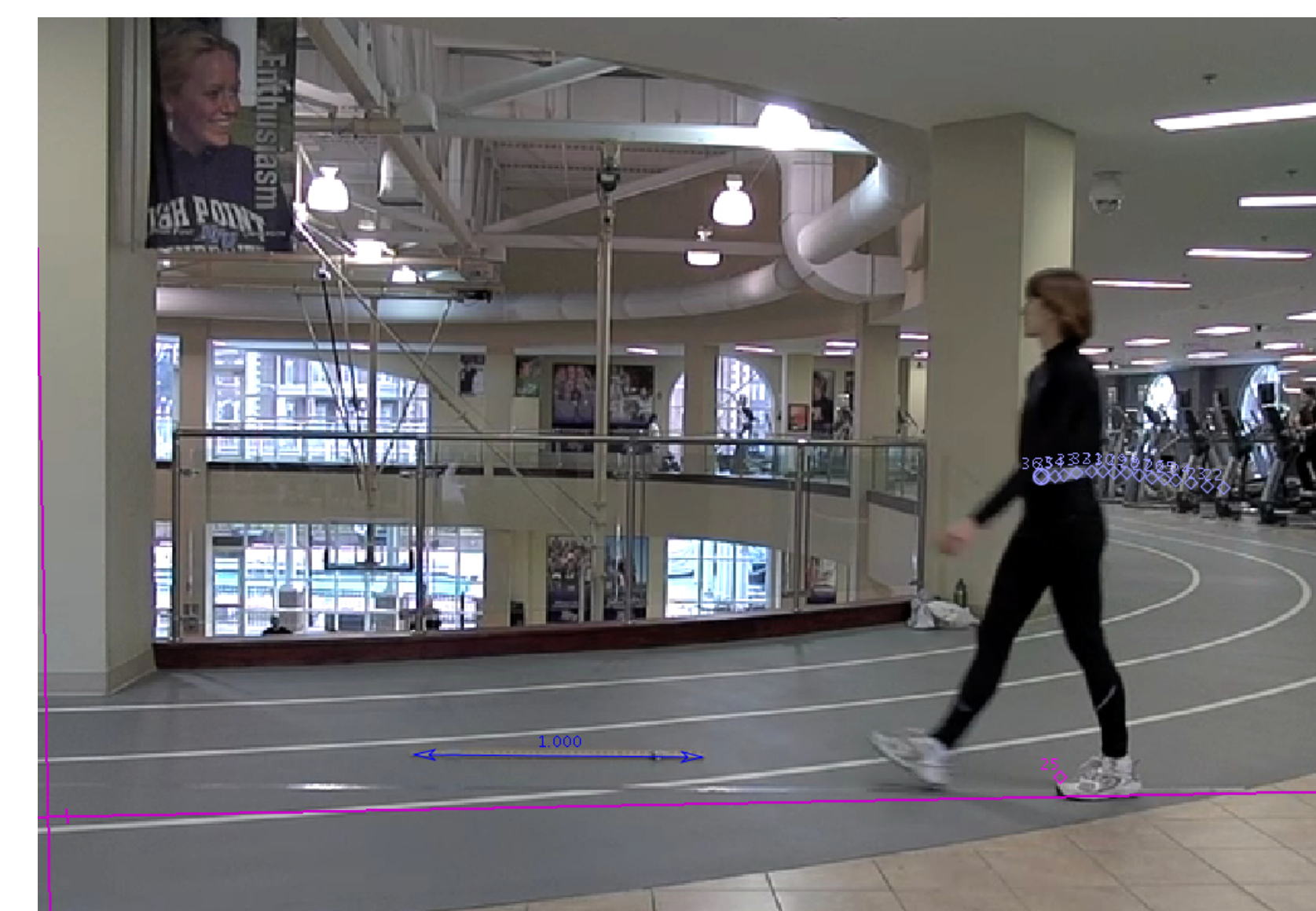
Gait parameters with no treadmill activity (VN = 7)

Parameter	Avg	Std Dev.	Relative Error (%)
N	5	0	0
SL (m/step)	0.898	0.00126	0.140
SF (steps/s)	1.645	0.495	30.091
v (m/s)	1.478	0.445	30.108
CM amp. (m)	0.0251	0.00215	8.528

Results Experiment 2

Gait parameters after treadmill activity (VN=5)

Parameter	Avg.	Std. Dev.	Relative Error (%)
N	4.75	0.5	10.52
SL (m/step)	0.793	0.0180	2.27
SF (steps/s)	1.790	0.0746	4.18
v (m/s)	1.420	0.0520	3.67
CM amp. (m)	0.0260	0.00333	12.81



Conclusions

- Treadmill activity produced a noticeable alteration in SL.
- Treadmill activity did not affect the average value of the other parameters.
- CM amp. variability did not change.
- SL and SF were more consistent following treadmill activity.
- Since treadmill activity only affected step length and parameter variability, it appears that the "treadmill effect" does not manifest itself as a change in gait parameters.

References

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- Jolie Johnson, *Vertigo After Using a Treadmill* (2010). LiveStrong web site.
- Tommy Oberg, *Basic gait parameters: Reference data for normal subjects, 10-79 years of age* (Journal of Rehabilitation Research, 1993), pp. 210-213.

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