

Variability of human gait: long-range autocorrelations and fluctuation magnitude of stride duration

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Human locomotion is a rhythmic process whose variability can be investigated in two different ways. The magnitude of the stride duration fluctuation can be addressed by classical mathematical methods (coefficients of variation) and are usually computed on about ten cycles. Fluctuation dynamics between strides can be characterized using the autocorrelation function computed by combining analysis of the Hurst exponent and of power spectral density over a large number of consecutive cycles (≥ 512) (Crevecoeur, J Neurosci Methods 2010). These analyses show that stride duration does not fluctuate at random but in a very complex way. Indeed, consecutive strides are characterized by correlations that can span over a large number of strides reflecting a centrally controlled behavior. Long-range autocorrelations are present among stride duration variability on level ground and on treadmill (Bollens, Gait&Posture 2010). They are not influenced by gait speed and subject age whereas coefficients of variation were inversely related to walking speed and the age of the subjects (Bollens, Neuroscience 2012). Long-range autocorrelations seem robust, being influenced by neither dual task walking nor backward walking (Bollens, Ann Biomed Eng 2013). Fluctuation magnitude and dynamics could be complementary tools for more complete gait characterization, in research and in clinical practice.

[back](#)