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Presentation title:

**Can movement patterns reveal the status of the musculoskeletal system? A complex approach to injury and recovery.**

Abstract:

Movement patterns result from non-linear interactions among several systems (e.g., nervous, cardiovascular, and musculoskeletal systems), which interact with the environment. To produce functional movement patterns, biological systems organize themselves in numerous ways within an environment that changes continually. This self-organizing process allows movement patterns to adapt to organismic, environmental, and task constraints in multiple ways. As a result of self-organization, movements have the potential to reflect the status of the many components involved in their genesis. Therefore, the time evolution of the movements' macrostructure can carry information about the interactions of their many microscopic components. Many studies have been conducted using non-linear methods to investigate human behavior. These methods have the potential to unveil the movement pattern structure and capture a signature of the status of the biological system. Within this reasoning, we have shown that individuals exposed to stressful situations present a

reduction in their ability to adapt to changes. This altered behavior indicates modifications of the available components of their biological systems, which may place the individual at risk of injury or performance reduction. Decreases in the system's ability to sustain proper movement patterns in response to perturbations may indicate that the individual is more susceptible to injury or re-injury. On the other hand, the ability of the individual to recover from stressful situations, such as sleep deprivation or high-demand exercises, may be essential in injury prevention. Therefore, the analysis of the time evolution of movement patterns may allow the capturing of the status of individuals and reveal whether they are at risk of injury or have successfully undergone a recovery process. In this presentation, we will demonstrate how entropy analysis (sample and multiscale entropy) can capture individuals' responses to perturbations and be used within the framework of injury prevention or recovery detection.

#### Short CV:

Sérgio Fonseca is a Full Professor at the Department of Physical Therapy of the Universidade Federal de Minas Gerais (UFMG), Brazil, and Director of the UFMG's Sports Training Center. He received a B.Sc. degree in Physical Therapy from UFMG, M.Sc. in Physical Therapy from the University of Alberta, Canada, and a Sc.D. in Applied Kinesiology from Boston University. He was also an invited scholar at the Center for the Ecological Studies on Perception and Action at the University of Connecticut. Currently, Dr. Fonseca is one of the Editors of the Brazilian Journal of Physical Therapy. He has published more than 150 articles in peer-reviewed journals. His research activities focus on applying Dynamic Systems and Ecological approaches to understand human movement, mainly in the areas of musculoskeletal rehabilitation and sports.