
Master thesis : Kinematic Profiling of Motor Patterns Using Body-Worn Sensors in Typically Developing Children and Adults: Establishing a Reference Framework for Future Assessment in Children with Neurodevelopmental Disorders (including introduction to research methodology)

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Kinematic Profiling of Motor Patterns Using Body-Worn Sensors in Typically Developing Children and Adults: Establishing a Reference Framework for Future Assessment in Children with Neurodevelopmental Disorders.

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Abstract

Motor development involves substantial changes in movement organization, coordination and control throughout childhood. Objective quantification of these changes could complement conventional clinical assessments and provide a basis for the future characterization of motor alterations associated with neurodevelopmental disorders. This study aimed to develop and evaluate a functional motor assessment protocol combining three-dimensional (3D) optoelectronic motion capture and wearable inertial measurement units (IMUs), and to investigate the potential of IMU-derived parameters for distinguishing typically developing children from adults.

A group of typically developing children aged 6-12 years and a group of adults were recruited to establish and compare their kinematic profiles. Participants performed eight experimental tasks assessing different aspects of motor function, including gait, postural control, fine upper-limb motor function, social interaction, and object affordance. 3D reflective markers and IMUs were positioned at C7, the pelvis and the dominant wrist. A broad set of movement features was extracted and classified into six categories: *Speed and Acceleration*, *Movement Smoothness*, *Efficiency*, *Control Strategy*, *Signal Complexity*, and *Inter-segmental Coordination*. Statistical comparisons were then performed between the two groups.

Significant differences between typically developing children and adults were identified across all eight tasks, although their magnitude and nature were strongly task- and parameter-dependent. The two-leg standing task yielded the largest proportion of significant parameters, while the drinking and pegboard tasks were also particularly discriminative. Overall, *Speed and Acceleration* and *Movement Smoothness* provided the largest number of significant differences, whereas *Signal Complexity* and *Inter-segmental Coordination* measures provided complementary information on motor organization. Importantly, approximately half of the significant parameters across tasks were derived from IMU measurements, demonstrating their substantial contribution to group discrimination.

These findings demonstrate that typically developing children and adults exhibit distinct quantitative kinematic profiles across a range of functional motor tasks. They support the ability of the proposed protocol to characterize developmental motor differences and highlight the potential of wearable IMUs to simplify quantitative motor assessment. This work provides an encouraging methodological basis for future application of the protocol to children with neurodevelopmental disorders and for the development of more accessible instrumented motor assessment approaches.