

SOFTWARE TOOL FOR SIGNIFICANT ANALYSIS OF COMPLEMENTARY DOMAINS AT HUMAN GAIT

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Summary: Over time many important contributions have been made at the methodological and technological level to the study of human movement with possible impact and applications at ergonomics, diagnosis of neuro-musculoskeletal diseases, treatment, rehabilitation and improvement of human movement performance. State of the art on human movement study increasingly points to the need of subject specific models and extraction of significant information for the intended objective. Recent developments on imageology and modeling have greatly contributed to detection of human kinematic patterns with the underlying causes of registered movement and translational research an open issue. Proposed tool presents as an upper layer software application taking subject specific entire series of internal and external kinematic, kinetic and electromyographic data from human movement acquisition software and musculoskeletal modeling and simulation tools, extracting and exhibiting in a user friendly graphic environment hidden features and relations of biomechanical signal at complementary time, frequency and phase domains. Developed software application is presented using modified and normal gait case study of subject specific model, grouping head, arms and trunk as the passenger of the locomotion system composed by the lower limbs interconnected through the pelvis. Presented features include 2D and 3D visualization, continuous and step by step animation of lower limb stick-figures according to joint cartesian coordinates, ground reaction and resultant force vectors during feet contact, hip, knee and ankle joint sagittal angular displacement, angular velocity and acceleration, flexion / extension joint force moments presentation with dynamic time line during normal gait, stiff knee and slow running tests. Time series analysis include boxplot, histogram, time profile, descriptive local and dispersion measurements of signals during selected time period, linear and cross-correlation, maximum correlation, time delay and animation, Fourier transform analysis, phase and amplitude, signal reconstruction and root mean square deviation, cross-spectral analysis, phase plane analysis, Rayleigh test, histogram and rose diagram, selected muscle action representation and analysis with magnitude, phase and combined measures. Presented tool aims to contribute for increase of translational research of human movement analysis into clinical gait diagnosis and rehabilitation, overcoming big data management complexity and unveiling hidden data relations on time, frequency and phase domains.