

DOCTORAL THESIS ABSTRACT

Mathematical model of the infants' spontaneous movement in the first year of life in the aspect of early movement disorders detection

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Preventive health care of children in the first years of life is a crucial task for population health due to the decisive influence of this stage of life on a human's health status and development. Early detection of developmental abnormalities, manifested in motor dysfunctions, gives a greater chance for the success of the therapy and improvement of the child's quality of life in the future. The current literature and knowledge gained through collaboration with physiotherapists identify the need to support early neurodevelopmental diagnosis possible through information technology.

This study aimed to develop and validate a mathematical model of infants' movement dynamics in the first year of life for diagnostic applications. The model is a component of a proposed metrological system to support the work of a specialist in rehabilitating neurodevelopmental disorders.

The proposed mathematical model of the dynamics of spontaneous infant limb movements, using the β curve to represent their velocity over time, was verified against the MINI-RGBD benchmark database. A measurement station with a video camera to record an infant lying on its back during spontaneous activity was used to collect a dataset of 50 healthy infants aged 6 to 16 weeks. They allowed for the development and validation of a method to acquire the motion trajectories of human pose landmarks. Based on the observation with a general movement assessment, the neurodevelopmental diagnostic expert divided the study group into two categories of fidgety movements. The initial verification of the proposed biomarkers in the context of diagnostic value and reproducibility of decisions was done with machine learning methods and statistical analysis.

The results confirmed the possibility of using the proposed model to represent the nature of normal fidgety movements. The created biomarkers of spontaneous movement dynamics are an extension of the indicators describing the spatial character of infant movements and postural patterns developed by an interdisciplinary team of researchers with the cooperation of the dissertation author.

Keywords: neurodevelopmental assessment; general movement assessment; computer-aided physiotherapy; mathematical modeling; movement dynamics analysis