Motion Tracking of Infants in Risk of Cerebral Palsy

Every year 2-3 out of 1000 infants are born with cerebral palsy. Among others, the disorder often affects motor, cognitive and perceptual skills. The disorder is usually detected when the infants are old enough to crawl and walk, i.e. when the infant is 1-2 years old. However, studies show that the infant’s movements are affected already in the first year of life and methods exist for assessing the movements. The methods often require observation of the movements and qualitative evaluation of these. A more objective measure is desired in order to be able to diagnose cerebral palsy much earlier.

The goal with this thesis is to describe the development of a markerless motion tracking system for infants. Based on data recorded with a low-cost depth sensor, image analysis and mathematical modeling is used to model the infant’s body and its movements. Two methods are considered, where the first method is able to do single frame pose estimation, based on simple assumptions on the infant’s body. The second method uses an articulated model that incorporates anatomical constraints. Combining the two methods results in a robust motion tracking system for infants.

The results from the motion tracking are used to extract physical features such as velocity and acceleration of the individual body parts. A novel method for estimating scene flow in human motion data is presented, utilizing the results from the motion tracking. A number of examples are given for potential applications for automatic assessment of infant movement. This includes a preliminary study on automatic classification of movements related to cerebral palsy.

The contributions included in this thesis can be divided into two groups. The first two contributions consider the analysis in order to estimate and track the body of the infants. The remaining contributions consider different motion features derived from the motion tracking results. Both pose and motion features are extracted and used for assessing the infants’ motor development.

The presented work is a step closer to automatic motion assessment of infants with focus on early diagnosis of infants with cerebral palsy. Further collaboration with clinicians can result in breakthroughs in the way infants are monitored and assessed during the early years of life.

The main motivation is to be able to assess infants in risk of cerebral palsy based on the previously established connection between infant movement and brain injuries. However, as the data used in this study is recorded simultaneously with the study, the true outcome is not known. Even though some of the included infants were born preterm, none of them have to date been diagnosed with cerebral palsy.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics
Contributors: Olsen, M. D., Paulsen, R. R.
Number of pages: 199
Publication date: 2016

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
(DTU Compute PHD-2015; No. 393).
Electronic versions:
phd393_Olsen_MD.pdf