博士論文審査結果の要旨

博士論文審査委員会

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論文題目	Investigation of Human Balance Ability and Development of a New Sensory Oriented Posture Control Model Based on Joint Stiffness Characteristic

〔論文審査の要旨〕

　本学位論文の目的は，高齢者や運動機能障害者に対する転倒予防を見据え，様々な外乱時におけるヒトの関節スティフネス測定を基にした姿勢制御戦略モデルを提案し，新たなバランス能力評価方法を提案することである．

　6軸モーションベースプラットフォームを用いて前後上下の様々な外乱を与えることができるシステムを開発し，3次元動作解析システムにてヒト立位姿勢における足関節および股関節の動的スティフネスを定量化し，バランス能力評価の新規性のある手法を提案した．健常成人のバランス能力の優劣と関節スティフネスとの関係を導き，高齢者や障害者の計測評価に展開するための極めて有用な結果を得ることができた．

　2015年8月1日（土）15時から約1時間のプレゼンテーション，その後約1時間の質疑応答を実施した．研究業績として，査読付論文2編，国際学会プロシーディングス多数あり，本学博士学位審査基準は達成されており，審査委員全員一致で，学位論文取得に充分な内容であることが承認された．

以上

論 文 要 旨
Thesis Abstract

(yyyy/mm/dd) 2015 年 07 月 03 日

※報告番号	第　　号	氏　名 (Name)	Aizreena Binti Azaman

主論文題名　（Title）

Investigation of Human Balance Ability and Development of a New Sensory Oriented Posture Control Model Based on Joint Stiffness Characteristic.

内容の要旨　（Abstract）

This research thesis introduces a new biomechanics approaches to determine balance disability and to enhance human postural control model in pursuance of developing a better balance ability assessment tool which allows for timely and targeted therapeutic intervention and rehabilitation. The concept of this research is to combine both functional and physiological assessment principal in order to find the key factor or parameter which can represent the resource of human control component. This research proposed a measurement of joint stiffness during normal and perturbed stance. Degree of posture movement during external perturbation applied much depended on effective joint stiffness. Three phase of investigation were performed. The first phase involved an interview session with physiotherapist about recent needs and effective assessment in evaluating balance ability. The second phase consists of clinical study. In this phase, individual were asked to undergo experiment to record posture movement and muscle activation when external platform perturbation is applied. In order to determine the effect of sensory information toward posture movement, three sensory input condition were applied (i.e., vision, vestibular sense, and somatosensory (from fingertip touch). Response of the ankle and hip joint stiffness at all conditions were measured and compared with a conventional balance assessment score (Functional Reach Test) with the aim of determining its correlation with balance ability.

Joint stiffness profile then were used to develop a new sensory oriented posture control model based on joint stiffness characteristic. The joint stiffness profile were later included in the close loop double inverted pendulum model to represent a neuromuscular control. The experiment results have shown that, joint stiffness value is able to discriminate different intensity of perturbation and sensory conditions where good balance condition generated less joint stiffness especially at ankle. Besides, it is also able to show a negative correlation (r>-0.5) with Centre of Mass (COM) where high stiffness is required to keep the body sway in a small range. The simulated result from the model have shown it able to generate existence of ankle and hip strategy at particular condition and simulated joint motion displacement almost followed the experiment data with absolute percentage difference less than 20% (considered close and near miss). This study concludes that assessment of balance ability via joint stiffness characteristic during perturbed stance provides a means for contributing to the development of a better assessment technique.

Keywords: Balance ability, joint stiffness, sensory manipulation, and perturbed stance.