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指導教員 承認印	
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## 学位（博士）論文要旨

(Doctoral thesis abstract)

論文提出者 (Ph. D. candidate)	工学府博士後期課程 電子情報工学 専攻 (major) 平成 28 年度入学 (Admission year) 学籍番号 16834702 氏名 Tran Nguyen Bao  印 (student ID No.) (Name) (Seal)
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論文題目 (Title)	A Study on Analysis of Biomechanical Factors in Skilled Dart Throwing (ダーツ投擲技能における生体力学的要因解析に関する研究)
論文要旨 (2000 字程度) (Abstract (400 words)) ※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。 (in English or in Japanese) Recently, sports science has been intensively investigated due to the demand for professional games. It is worth understanding the underlying mechanisms of the brain and motor system of human, which attribute skills and strategies of experienced players to improve the performance of athletes and coaching practice. This thesis investigates biomechanical factors in dart throwing to gain insight into motion expertise in terms of kinematics and muscle activities.  Kinematics parameters and electromyography (EMG) of eight skilled dart throwers were simultaneously recorded by a motion capture system and EMG recording system while performed a task of 42 throws. A system of six high-speed cameras was used to capture movements of the trunk, shoulder, elbow, wrist, thumb, and dart. The kinematic data were synchronized with EMG signals of eight muscles along the throwing arm. Vertical error curves derived from the hand and dart trajectories were calculated for timing sensitivity analysis to distinguish the strategies	

of the experts. Moreover, in EMG analysis, muscle activities of *Biceps brachii* (antagonist) and *Triceps brachii* (agonist) at the elbow joint were investigated to evaluate the characteristic in the neuromuscular system of skilled throwers. That is, the antagonist muscle activity of the experts was relatively low as compared to novices. Additionally, muscle synergies in dart throwing movement were analyzed to provide evidence to the muscle synergy hypothesis.

Results showed that there were two throwing strategies according to the length of time-window for the successful release, i.e., small timing sensitivity and small timing error. These strategies were characterized by a spatiotemporal relationship between the hand and dart trajectory during the acceleration phase, the released dart's velocity, and wrist angular acceleration. In terms of EMGs, co-activation, which is considered as a negative phenomenon in throwing task, was relatively low in experienced throwers as compared to the beginners. Clarifying characteristics of experts' strategies would be informative for scientists in motor control. Furthermore, three muscle synergies were identified to explain sufficiently the observed EMG data of ten individual muscles, which could support the hypothesis.

This thesis is the first study that has elucidated strategies of high skilled dart throwers by a comprehensive analysis on kinematic parameters of human joints, hand and dart trajectories, and muscle activations.

(英訳) ※和文要旨の場合(400 words)