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The Research of Quantized Limb Movement Capability Assessment Indicators for the Elderly

Azhen Zhang[1], Guangchen Yang[2], Peng Yang[1] and Jianliang Liu[3]

[1]School of Control Science and Engineering, Hebei University of Technology, Tianjin 300130
[2]Tianjin Medical University General Hospital, Tianjin 300070
[3]College of Management and Economics, Tianjin University, Tianjin 300072
[1]azzhang1205@126.com
Corresponding Author: lzqsly@126.com

Abstract

As the problem of aging population is going to exacerbate, improving the scientific and objective nursing and service for the aged becomes the trend of pension industry. The premise of scientific pension service is assessing the capability of the elderly objectively. Then we can grade the capability of the elderly and provide different types of old-age care for different grades of the elderly. To solve this problem, this thesis puts forward a kind of quantized limb movement capability assessment indicators' system for the elderly by analyzing human limb movement mechanism and the International Classification of Functioning, Disability and Health. This thesis also puts forward a method of data collection by using Vicon Three-dimensional motion capture system. Therefore, it provides an objective basis of elderly capability assessment method in the scientific pension.

Keywords: *pension, assessment, capability, indicator*

1. Introduction

As we all know, whether it is at present or in the next period of time, the problem of aging population is the main challenge faced by domestic and international community. Each country has its own unique pension model. Western countries use hierarchical management model for the elderly in the pension agencies. They grade capabilities of the elderly according to health status, status of daily living and ability of social interaction. And capabilities can be classified into three types, which are valid healthcare, semi-valid healthcare and invalid healthcare respectively. The elderly with different capability types would live in different types of pension agencies. There are mainly old people's homes, nursing homes and hospice agencies [1-2]. For example, French society implements entirely society-supporting pension. It defines pension facilities as public agencies which are divided into four types including hospices, houses for the elderly, nursing homes and medium to long term health hospitals. Sweden implements welfare pension, and its basic objective is to make the elderly have a reliable source of income, good housing conditions and necessary social services. Besides, it can also make the elderly have chances to participate in various social activities. America implements pension supported by community and state, its pension manner emphasizes on community care while providing various national insurances for the elderly [3-5]. In addition to the developed countries in Western, Japan also has its own pension system. Japan implements pension provided by family and society, which establishes "perfect society" based on self-reliance, family-reliance, community- reliance and the support of state. And it introduces care insurance to protect the elderly, especially the senile people [6].

Compared with aforementioned countries, population aging in China faces a tendency

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of "large amount, fast growth". Chronic Noninfectious Diseases become the most important part in disease spectrum and it naturally leads to disability which brings about a heavy burden to the patient, the family and society [7]. In addition, single-child policy of China makes people's pension pressures increasingly remarkable. So the system of national pension service attracts more and more attentions [8]. In this background, we need to develop scientific and wholesome pension services to solve this problem. However, the pension service system of China is still in start-up phase, so the thinking pattern, infrastructure, service system, operational mechanism, scientific and technological support are not integrated. In addition, the related domestic and overseas organizations make the pension standards almost by using subjective assessment indicators except some medically pathological indicators. So there is not a kind of objective, quantified and thorough assessment methods. To make the old-age care more and more professional, it is very important to do scientific and objective assessment for the elderly. Additionally, among all the capacities of the elderly, limb movement is crucial for the daily life, social interaction and other capabilities of the elderly. In this premise, this thesis will make an objective assessment of limb movement capability for the elderly. By analyzing the theory of human limb movement and combining the related entries in the International Classification of Functioning, Disability and Health (ICF), this thesis puts forward a kind of scientific, quantitative and practical assessment indicators to provide a scientific basis for the pension service.

2. The Theory of Human Limb Movement

Joint movement plays a decisive role in the assessment of human limb movement function. It occurs when the joint moves around different motion axis in different moving planes between two bony articular surfaces which make up the joint. However, the main function of skeletons are sustaining and movement, they are connected by joints. Skeletons rotate the hinge joint by the way of series-parallel mixed structure. Therefore, in the process of studying the theory of limb movement, this thesis focuses on analyzing the joints which have a greater influence on activities of the elderly.

2.1. The Main Features of Human Upper Limb Joints

Human upper limbs generally take on more complex and elaborate work, and its motor function can directly affects people's ability of daily living. Therefore, in order to assess the capability of human upper limb movement, we must study the major features of upper limb joints.

Anatomically, broadly speaking, shoulder joint is a complex joint including scapular joint, glenohumeral joint, acromioclavicular joint, sternoclavicular joint, coracoclavicular joint and scapulothoracic joint. The glenohumeral joint plays the primary role of movement which is made up of humerus and scapular glenoid cavity. And it is a typical joint of ball and socket. Caput humeri is relatively large and spherical, its glenoid cavity is shallow and small which wraps only one-third of the caput humeri, and the joint capsule is thin and slack. Because of these features of caput humeri, shoulder joint is the most flexible joint. And it has the largest range of motion. Shoulder joint can make flexible multi-axis motion, such as flexion, extension, adduction, exhibition, rotating and ring switch. These anatomically structural features ensure the flexibility of shoulder joint, but they make the stability of shoulder joint worse than other joints. Thus, Shoulder joint is the most unstable joint in the body. Therefore, we need make scientific and safe assessment based on the features of shoulder joint.

In addition to the shoulder joint, elbow joint also has an important influence on upper limb motor function. Elbow joint consists of lower humerus and the top of ulna and radius, including three joints namely humeroulnar joint, humeroradial joint and proximal

radioulnar joint respectively. It can do flexion and extension movement and it also participates in pronation and supination movement of the fore arm.

2.2. The Main Features of Human Spine Joints

Human's spine is composed of 7 pieces of cervical vertebra, 12 pieces of thoracic vertebra, 5 pieces of lumbar , sacrum and coccyx. It is the bony structure which connects with intervertebral joints from top to bottom. It has functions of supporting the trunk, protecting the internal organs and spinal cord, exercising. And lumbar vertebra is easy to occur hyperplasia and degeneration. Therefore, human's spine has an obvious influence on functional activities of the elderly.

Assessing the capability of human lumbar spine needs to analyze the features of spinal joints. Spine is made up of vertebrae and the intervertebral disc, and it is the backbone of the body. Its structure is characterized by softy and mobility, which depends on the integrity of intervertebral disc and the harmony between the related vertebrae joints. Lumbar vertebra is much larger. Its spines slab level is towards the rear. The gap between adjacent spinous process is so wide that it can be used of lumbar puncture. And the articular process is perpendicular to the articular surface. When human body withstands vertical loads, lumbar spine has the function of buffering pressure. It can prevent the brain concussion while walking, jumping and running. From the needs of basic daily activities, lumbar section of the spine joint plays an important role in the movement of the elderly. Whether the lumbar section of spine joint is flexible or not can decide daily activities of the elderly is convenient or not.

2.3. The Main Features of Human Lower Limb Joints

The structure of human lower limb is a key factor in the limb movement which plays a supporting, loading and balancing role. Lower limb bones are mainly composed of femur, small leg and foot bones. Then lower limb joints mainly include hip joints, knee joints and ankle joints.

Hip joint is made up of acetabulum and femoral head which is the most typical and perfect pestle mortar joint of a body. Femoral head in human body plays an important role in weight and exercise, and it bears weight of entire torso. Therefore, hip joint is the largest weight-bearing joint of a body. It will not only be able to convey the weight of the body to lower limbs, but also can accomplish the movements of flexion, extension, adduction, abduction, internal rotation, and external rotation within quite a range.

Knee joint is the hub of lower limb activity which is made up of distal femur, proximal tibia and patella. Knee joint bears a greater weight and large amount of exercise. It is the most complex joint in the human body. Human daily life, such as standing, walking, running, jumping and so many activities, are inseparable from the movement of knee joint.

Ankle joint is formed by lower tibia, lower fibula and talus, the main function of which is to bear weight. Ankle joint is an important part of the body in contact with the ground, and it plays a significant role in human lower limb activities. For example, foot motions are mainly dominated by the ankle, especially the motions of foot dorsiflexion and plantar flexion occur mainly in the ankle joint.

3. The Selection of Assessment Factors

The limb joint parameters, *i.e.,* range of motion can be considered in the selection of assessment factors for older people's motor function. Range of motion (ROM) refers to the maximal radian which joints can reaches. Joint movement is divided into active motion and passive motion, so there are active range and passive range in the range of joint motion. Active range of joint motion refers to the motion radian that related muscles

shrink at random leading to the joint moves. Passive range of joint motion refers to the motion radian that joint moves on account of external force. In the assessment of limb movement function for the elderly, we need to assess the ability of daily living of the elderly. So the assessment factors are mainly selected as active range of joint motion. The range of joint motion here refers to the active range of joint motion (the same blow). We should replace the joint function loss with the comparison of active range of joint motion and normal range [9]. Before selecting joint motion indicators, various terms of anatomical location and joint angular motion should be introduced. So the description of subsequent assessment indicators can be easily understood.

Table 1. Terms of Body Position

orientation	definition
up（cranial）	Close to the top of the head
down（caudal）	Close to the foot
front（ventral）	Close to the front of the body（venter）
back（dorsal）	Close to the back of the body（back）
inside	Close to the middle
outside	Away from the center

Firstly, orientation is the positional relationship between a structure and other structures of a body. Table 1 describes six kinds of related orientation terms and their definitions. Secondly, joint angular motion refers to the motion that two adjacent bones are away from each other or close to each other. It leads to the changes in joint angles which include flexion-extension and contract-stretch movements. On one hand, flexion-extension movement refers to the movement that joints moves along the coronal axis. Flexion refers to the movement that two related bones are close to each other or the angle is reduced, extension is on the contrary. Coronal axis refers to the ligature between two symmetry points of the body, and it is parallel to the ground. On the other hand, contract-stretch movement refers to the movement that joints move along the sagittal axis. Contract refers to the movement that bones move to median line, stretch is on the contrary. Sagittal axis refers to the axis which is from abdominal side to back side and intersect with vertical axis at right-angle.

The analysis of limb movement above shows: the main indicators which influence the basic activities of old people's upper limbs are the range of shoulder joint motion and the range of elbow joint motion; the main indicator which influences the basic activities of old people's lumbar is the range of spine joint (waist) motion; the main indicators which influence the basic activities of old people's lower limbs are the range of knee joint motion, the range of hip joint motion and the range of ankle joint motion. The section below will introduce the range of each joint motion in brief.

(1) Shoulder joint: it moves flexibly and it is able to complete a variety of motions. The normal range of activities which influences basic activities of the elderly are: in the case of dropping upper arm and flexing elbow, the range of flexion is 150°～170°, the range of rear protraction is 40°～45°, the range of abduction is 80°～90°, the range of adduction is 20°～40°.

(2) Elbow joint: its main motions are flexion and stretch. The normal range of flexion is 135°～150°, the normal range of stretch is 0°.

(3) Spine joint (waist) : lumbar motion has much influence in limb movement of the elderly, its main motions are as follows: anteflexion 80°～90°, rear protraction 20°～30°, on the left side of the bow 20°～30° and on the right side of the bow 20°～30°.

(4) Hip joint: the main motions which has bigger influence on limb movement of the elderly are as follows: flexion 130°～150°, rear protraction 10°～15°, adduction 20°～30°, abduction 30°～45°.

(5) Knee joint: its main motions are flexion (120°～150°) and extension (0°), these kinds of movements have bigger influence on limb movement of the elderly.

(6) Ankle joint: its main motions are dorsiflexion and plantar flexion, these kinds of movement have bigger influence on basic walking activity of the elderly. Dorsiflexion refers to the movement that the foot back is close to the front leg. On the contrary, plantar flexion refers to the right-angle position that the foot back is away from the front leg. And the rest position refers to the foot is perpendicular to the leg. The normal range of dorsiflexion is 20°～30°, and the normal range of plantar flexion is 40°～50°.

4. The Establishment of Assessment Indicators' System

4.1. The Establishment of Limb Movement Assessment Indicators for the Elderly

The aforementioned analysis about the theory of human limb movement shows that limb movement function of the elderly can be assessed from the perspective of the main joints' activities. However, the premise of establishing assessment indicators' system is to judge whether aforementioned ROMs has influence on daily living ability of the elderly or not. The ROMs are the ranges of shoulder joint motion, elbow joint motion, spine joint (waist) motion, knee joint motion, hip joint motion and ankle joint motion respectively.

Table 2. ICF Core Clusters-- Activities of Daily Living

Indicators	Field	Dimension	ICF Code	ICF Items
Feed	Activity and participation	Activity	d4452	Stretch out one's hand
	Activity and participation	Activity	d4453	Turn or rotate the hand or arm
	Activity and participation	Take care of oneself	d550	Eat something
Bath	Activity and participation	Take care of oneself	d510	Wash one's own body
	Activity and participation	Take care of oneself	d5100	Wash all parts of the body
Modify	Activity and participation	Activity	d4453	Turn or rotate the hand or arm
	Activity and participation	Activity	d4458	The use of hand and arm in other designated areas
	Activity and participation	Take care of oneself	d520	Care all parts of the body
Clothe	Activity and participation	Take care of oneself	d540	Clothe
Go to the toilet	Activity and participation	Activity	d410	Change the basic position
	Activity and participation	Activity	d4104	To one's feet
	Activity and participation	Take care of oneself	d530	Go to the toilet
Transfer the bed	Activity and participation	Activity	d410	Change the basic position
	Activity and participation	Activity	d4104	To one's feet
	Activity and participation	Activity	d420	Move oneself
	Activity and participation	Activity	d4200	Move oneself in sitting position
	Activity and participation	Activity	d4201	Move oneself in lying position
Walk on the ground	Activity and participation	Activity	d450	Walk
Walk up and down stairs	Activity and participation	Activity	d4600	Move around inside the house
Living ability	Activity and participation	Genetic task	d2100	Engaged in simple tasks
	Activity and participation	Genetic task	d230	Complete daily activities
	Activity and participation	Activity	d430	Lift and hand objects
	Activity and participation	Activity	d470	Using vehicles
	Activity and participation	Take care of oneself	d570	Take care of personal health
	Activity and participation	Home life	d630	Prepare meals
	Activity and participation	Home life	d640	Do housework

Social intercourse ability	Activity and participation	Interchange	d3600	Use communication equipment
	Activity and participation	Home life	d660	Help others
	Activity and participation	Social life	d920	Entertainment
	Activity and participation	Social life	d9205	Social activity

In order to establish limb movement ability indicators for the elderly, we must combine the limb movement function with the daily living abilities. This thesis analyzes the factors of affecting daily living ability of the elderly according to the International Classification of Functioning, Disability and Health (ICF). ICF is issued by World Health Organization. It is not only the first classification to share a common function, diseases and health signs, but also a widely used tool of assessment and measure. ICF has a detailed and comprehensive classification which covers all areas of functional health. And it also provides an international language and a uniformly theoretical framework to describe the health status and individual activities. ICF is widely used in the areas of health and disability over various parts of the world [10-12]. As the standard of investigation and statistics for the elderly, it provides a platform for measurement and data acquisition. Therefore, in the application of limb movement capability assessment for the elderly, ICF has scientifically guiding significance and ideal practical basis. This assessment model is easily recognized and accepted in domestic and overseas.

This thesis selects the items which are suited for the limb movement capability of the elderly according to ICF. The selection is based on the content of body functions, body structures, activities and participations, environment factors and so on from ICF [13-14]. These items provide a reliable basis for the establishment of limb movement capability assessment indicators, they are shown as Table 2. It is worth noting that “the elderly” should be distinguished from ordinary adults in the item selection. For example, the items involving working ability, running ability and the ability to engage in complex tasks are not suitable for the elderly obviously [15]. It can be seen from Table 2, that the areas involving limb movement capability of the elderly mainly include the aspects which are activity and participation. Activity refers to perform a task or act by individual which represents the individual aspects of the function. Participation refers to put individual to the whole environment which represents the social aspects of the function. The problems of activities and participations will affect the main areas of general tasks, communication, self-care and interpersonal relationship of the elderly.

Table 3. Limb Movement Evaluation Indicators for the Elderly

First class indicators	Second class indicators	Parameter selection		Quantitative criteria
Capability of upper limb motion	Capability of shoulder joint activity	Neutral position: Upper arm dropping, elbow flexion	flexion	150°—170°
			Rear protraction	40°—45°
			abduction	80°—90°
			adduction	20°—40°
	Capability of elbow joint activity	Neutral position: fore arm straight	flexion	135°—150°
			extension	0°
Capability of lumbar activity	Capability of spine joint (waist) activity	Neutral position: body is erect	anteflexion	80°—90°
			Rear protraction	20°—30°
			On the left side of the bow	20°—30°
			On the right side of the bow	20°—30°
Capability of lower limb motion	Capability of knee joint activity	Neutral position: knee joint straight	flexion	120°—150°
			extension	0°
	Capability of hip joint activity	Neutral position: body is erect, knee flexion	flexion	130°—150°
			Rear protraction	10°—15°
			abduction	30°—45°
			adduction	20°—30°
	Capability of ankle joint activity	Neutral position: sitting position, feet off the ground naturally	dorsiflexion	20°—30°
			Plantar flexion	40°—50°

Thus it can be seen that daily living and social participation are affected by the limb movement capability of the elderly. Completing the daily living activities in Table 2, is closely with the range of shoulder joint motion, elbow joint motion, spine joint (waist) motion, knee joint motion, hip joint motion and ankle joint motion. Therefore, this thesis puts forward a kind of limb movement capability assessment indicators' system as shown in Table 3. The selection of assessment indicators is based on the key factors which influence the limb movement of the elderly.

4.2. The Application of Assessment Indicators by the Use of Equipment

The purpose of this thesis is to assess limb movement capability of the elderly, and the basic of which is the formulation of assessment indicators. Therefore, the key of assessment is to collect data by utilizing the indicators in this thesis. And the basic method of detection is to identify the behavior and action of the elderly by the way of video surveillance. This thesis helps the elderly to do test of limb movement capability by using Vicon Three-dimensional motion capture system, so that it can realize the function of human motion capture and tracking. The Vicon system is shown as figure 1. This system uses a high-speed infrared camera with two million pixels, the highest frequency of which is 500HZ, and the CMOS sensor of which is developed of Vicon company. Motion capture has become a widely used method which can show the details of human motion veritably. This method has a wide application prospect in film production, virtual reality, sports medicine robot control, game production and so on.

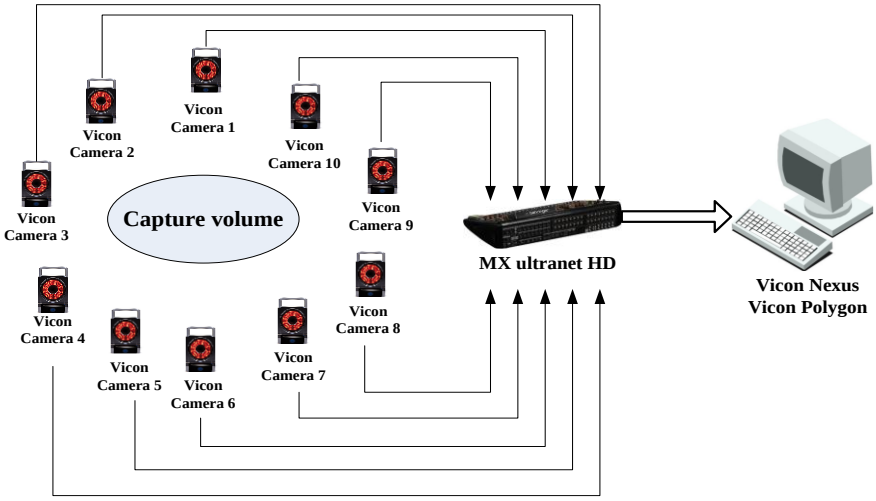

Figure 1. Vicon Dimensional Capture System

The principle of Vicon Three-dimensional motion capture system is as follows. It captures luminous markers by using the high-speed infrared camera. Then it constructs the data acquisition and analysis system of three-dimensional motion. And it can calculate the three-dimensional coordinate of reflective balls according to the image of reflective balls which move in the same sampling time. The image is scanned by different cameras. The data acquisition software of Vicon Nexus can collect data in real-time, and it can define the measurement and data analysis model by analyzing kinematics and dynamics based on the coordinates. Therefore, evaluators can get angle data of investigative objects that the assessment needs. Table 4, is the sample form of data collection that formulates for assessment indicators [16]. Evaluators can collect related joint angle data by using Vicon Three-dimensional motion capture system based on this table. Then, the limb movement capacity of the elderly can be assessed by the collection data. According to this method, we can realize scientific analysis and assessment of limb movement capability for the elderly.

Table 4. Sample Form of Data Collection

Collection parts	The angles of the specific motion（unit：°）			
shoulder joint	Left limb		Right limb	
	flexion	161.33	flexion	171.56
	Rear protraction	48.92	Rear protraction	40.88
	abduction	162.75	abduction	177.33
	adduction	39.65	adduction	44.90
elbow joint	Left limb		Right limb	
	flexion	135.01	flexion	145.39
	extension	0	extension	0
Knee joint	Left limb		Right limb	
	flexion	139.40	flexion	106.47
	extension	0	extension	0
hip joint	Left limb		Right limb	
	flexion	101.53	flexion	105.56
	Rear protraction	24.37	Rear protraction	19.05
	abduction	51.28	abduction	59.13
	adduction	10.75	adduction	17.76
ankle joint	Left limb		Right limb	
	dorsiflexion	28.60	dorsiflexion	24.03
	Plantar flexion	47.92	Plantar flexion	43.78
spine joint (waist)	anteflexion	85.25		
	Rear protraction	20.06		
	On the left side of the bow	28.48		
	On the right side of the bow	24.62		

5. Summary

With the problem of aging population is going to exacerbate in society, this thesis compares the current situation of domestic and foreign pension model. Firstly, by analyzing the theory of human limb movement, we get a series of key joints and parts which mainly affect the basic living activities of the elderly. Secondly, this thesis puts forward a kind of quantized limb movement capability assessment indicators for the elderly by combining with related terms in the International Classification of Functioning, Disability and Health (ICF) standard. Finally, this thesis illustrates the application of assessment indicators by using the principle of Vicon Three-dimensional motion capture system. Consequently, this thesis forms an integral assessment system of limb movement capability for the elderly. It provides a reference for the study of elderly limb movement capability methods, so that it lays a foundation for the development of scientific pension care.

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References

[1] K. Kokkonen, S. Rissanen and A. Hujala, "The match between institutional elderly care management research and management challenges - a systematic literature review", Health Research Policy and Systems, vol. 10, no. 1, **(2012)**, pp. 1-15.
[2] D. Auth, "Economization of long-term care in Great Britain, Sweden and Germany", Zeitschrift Für Gerontologie Und Geriatrie, vol. 45, no. 7, **(2012)**, pp. 618-623.
[3] B. Gannon and B. Davin, "Use of formal and informal care services among older people in Ireland and France", European journal of Health Economics, vol. 11, no. 5, **(2010)**, pp. 499-511.
[4] R. Stolt, P. Blomqvist and U. Winblad, "Privatization of social services: Quality differences in Swedish elderly car", Social Science and Medicine, vol. 72, no. 4, **(2011)**, pp. 560-567.
[5] K. Josefsson, "Registered nurses' health in community elderly care in Sweden", International Nursing Review, vol. 59, no. 3, **(2012)**, pp. 409-415.
[6] J. Ho and Kwon, "Risk Management and Life Supporting System for the Elderly Living Alone or with a Spouse only : A Comparative Study between Korea and Japan", The Journal of Asian Studies, vol. 16, no. 2, **(2013)**, pp. 1-24.
[7] E. Topinkova, "Aging, disability and frailty", Annals of Nutrition and Metabolism, vol. 52, **(2008)**, pp. 6-11.
[8] G. Kiira and B. Huang, "Elderly care and the one-child policy: concerns, expectations and preparations for elderly life in a rural Chinese township", Journal of cross-cultural gerontology, vol. 29, no. 1, **(2014)**, pp. 25-36.
[9] C. Qingmu, L. Wei and W. Yeqiong, "Comparison between Different Calculation Methods of Limbs Joints Function", Journal of Forensic Medicine, vol. 27, no. 4, **(2011)**, pp. 256-259.
[10] World Health Organization, "International Classification of Functioning, Disability and Health (ICF)", Geneva: World Health Organization, **(2001)**, pp. 1-283.
[11] World Bank and World Health Organization, "World Report on Disability (WRD)", Geneva: World Health Organization, **(2011)**.
[12] Z. Y. Qiu and D. Chen, "Theory and Approach of Measurement of Disability and Functioning Using ICF Model", Chinese Journal of Rehabilitation Theory and Practice, **(2010)**.
[13] M. Yang, L. Luo and J. Jiang, "Development of the elderly disability assessment scal (1): The selection of items for the preliminary version", Chinese Journal of Rehabilitation Medicine, vol. 29, no. 2, **(2014)**, pp. 113-118.
[14] M. Yang, L. Luo and J. Jiang, "Development of the elderly disability assessment scal (2): The selection of items for the formal version", Chinese Journal of Rehabilitation Medicine, vol. 29, no. 3, **(2014)**, pp. 212-217.
[15] M. Yang, J. Jiang and L. Luo, "Dong Birong. The disability assessment scale for the elderly", Chinese Journal of Rehabilitation Medicine, vol. 29, no. 4, **(2014)**, pp. 395-398.
[16] People's Republic of China Ministry of Civil Affairs, "Elderly capacity assessment (Draft)", The Civil Affairs Industry Standard of People's Republic of China, **(2013)**.

Authors

Azhen Zhang, received Bachelor degree in automation from Hebei University of Technology, in 2013. She is currently working toward Master degree in Control Science and Engineering form Hebei University of Technology.Her mainly research direction is computer control and engineering application.

Guangchen Yang, graduated from the Central South University Xiangya Medical college in 2005. Now as the clinicians in the rehabilitation department of Tianjin Medical University General Hospital. His main research direction is the rehabilitation treatment of orthopedics disease.

Peng Yang, received PhD degree in Electrical Engineering from Hebei University of Technology, P.R.China, in 2001. He is currently a professor and dean in the School of control science and engineering, HEBUT. His research interests are in system modeling and control, service robot and intelligent prosthesis.

