出國報告（出國類別：開會）

參加「2018年第20屆國際人因工程研討會」

服務機關：行政院勞動部勞動及職業安全衛生研究所
姓名職稱：陳志勇 研究員兼組長
派赴國家：義大利
出國期間：107年8月24日至8月31日
報告日期：107年9月25日

摘 要

出國報告名稱：參加「2018年第20屆國際人因工程研討會」
服務機關：行政院勞動部勞動及職業安全衛生研究所
姓名職稱：陳志勇 研究員兼組長
出國類別：開會
派赴國家：義大利
出國期間：107 08 24-31
報告日期：107 09 25
關 鍵 詞：人因工程、滑跌倒、肌肉骨骼傷病

內容：IEA International Ergonomics Association)是國際上各區域人因工程組織所形成的協會，我國人因工程學學會(EST: Ergonomics Society of Taiwan)亦為其會員。研討會提供一個類似平台的功能，作為各國人因工程專家交換與傳播研究資訊的場域。大會安排專題演講(keynote presentation) 、論文發表(parallel sessions) 、海報論文(poster sessions)以及展示(exhibitions)等活動。每三年舉行一次來自各國人因工程專家千人與會，上千篇論文發表。今年在義大利佛羅倫斯舉行本次主題涵蓋目前人因工程在各領域的研究包括職業人因工程(occupational ergonomics)、人因工程與設計(ergonomics and design)、病人安全(patient safety) 、新科技相關應用如人工智慧、機器人(artificial intelligence、robotics technology)等等數十個議題。本次發表本所研究成果:(1)我國勞工3D頭型人體計測與呼吸防護具；(2) 勞工BMI與物品重量對行走時地面磨擦係數之影響。為深入了解國際研究現況並與國際專家進一步接觸，我們亦參與「滑倒、絆倒與墜落」技術委員會會議。論文發表期間人體計測委員會專家希望進一步了解我國人體計測研究，邀請研究人員參與下屆委員會；國際標準專家提供標準技術委員會第4工作小組(ISO TC 159/SC3/WG4 Biomechanics)的連絡資訊供我們參考，希望有機會可以進一步參與相關的工作。但這些都需要投入額外的人力時間與出國預算。

目 次

壹、目 的

IEA （International Ergonomics Association)是國際上各區域人因工程組織所形成的協會，我國人因工程學學會(EST: Ergonomics Society of Taiwan)亦為其會員。研討會提供一個類似平台的功能，作為各國人因工程專家交換與傳播研究資訊的場域。大會安排專題演講(keynote presentation) 、論文發表(parallel sessions) 、海報論文(poster sessions)以及展示(exhibitions)等活動。每三年舉行一次來自各國人因工程專家千人與會，上千篇論文發表。2021年會議將在加拿大溫哥華舉行。

本次參加IEA國際研討會主要有兩個目的:

一、 發表本所研究成果:

(1) 我國勞工3D頭型人體計測與呼吸防護具(Development of Standard 3D Human Heads of Taiwanese Laborers for Respiratory Mask)報告我國長期以來在人體計測方面的研究成果，及其應用在勞工肌肉骨骼傷病之預防。

(2) 勞工BMI與物品重量對行走時地面磨擦係數之影響(The Friction Requirement for Different Body Mass Index of Workers under Various Loadings)。

因應國內事業單位工安人員日愈關注人因工程危害與職業性肌肉骨骼傷病，我們持續與與會專家交流此方面研究議題。

二、 積極參與IEA技術委員會:

(1) 參與「STF: 滑倒、絆倒與墜落」技術委員會會議。

(2) 論文發表期間人體計測委員會專家希望進一步了解我國人體計測研究，邀請研究人員參與下屆委員會。

(3)國際標準專家提供標準技術委員會第4工作小組(ISO TC 159/SC3/WG4 Biomechanics)的連絡資訊供我們參考，希望有機會可以進一步參與相關的工作。

貳、過 程

一、參加IEA國際人因工程研討會

本次IEA（國際人因工程協會）年會與會人員來自世界70餘國，有1576篇論文發表，其中860篇口頭報告411篇海報論文。此次研討會論文審查委員主要是由19個技術委員會(TCs: Technical Committees)399位專家組成，IEA共有27個技術委員會。這些技術委員會相當程度是各該領域的主要研究方向引導與研討會論文發表子題規畫的組織。IEA參與之人員與論文發表的規模相當大，涵蓋如人因工程與肌肉骨骼傷病、飛航人因工程、病人安全、人因工程與設計、中高齡人因問題、新科技有關的人因問題、以及數位模擬等等次領域的子研討會，可以說包括了人因工程在各領域的應用，列舉如下:

Activity Theories for Work Analysis and Design
Observations in actual work situations: Is this method still a key part of ergonomics practices?
The Goldilocks Principle: Innovative work design for improved health
Working conditions surveys and ergonomics

Aerospace Human Factors and Ergonomics
Innovative Human Performance Measurements supporting Future Automation challenges in Aviation

Aging
Aging and physical activity at work – Holtermann Andreas
Sustainable employment and the ageing workforce

Auditory and Vocal Ergonomics
Reducing alarm fatigue through ergonomic audible warning design

Ergonomics for Children and Educational Environments
Ergonomics challenges in the rapidly evolving digital world of children internationally

Ergonomics in Advanced Imaging

Ergonom ics and Human Factors in Radiology: A good test bed for a systemic approach to the visual, organizational and cognitive ergonomics issues

Ergonomics in Design

Designing tangible interfaces for human wellbeing – Caon Maurizio
Ergonomic Applications for Working Smart and Living Smart
Ergonomics/Design/Creativity in product innovationProspective Ergonomics: Ideating and designing future things

Ergonomics in Design for All

Designs for Accessibility in Home Appliances
New aspects and items for the standardization in the field of ergonomics

Forensic Human Factors

Forensic Human Factors and Ergonomics: Theory and Reality l
Forensics Human Factors: Human Behavior and Safety Issues
Research and Data in Ergonomics: Technology and Physical Discomfort

Gender and Work

Ergonomic analysis of work activity and training: evolutions of basic paradigms and creativity in practices
Gender, Work and Health in Ergonomics: Considering sex and gender (s/g) in methods
Gender, Work and Health in Ergonomics: Evaluating ergonomic interventions as a function of sex/gender-sensitivity
Gender, Work and Health in Ergonomics: Transformative approaches to foster health and equity

Healthcare Ergonomics

A partnership between citizens and healthcare organizations to assess and improve patient safety
Getting ahead of the curve: can we intervene successfully to influence the frequency of medication errors?
International perspectives on the application of a standardised approach for multi-dimensional time and motion studies using WOMBAT to study work efficiency and safety
New challenges for managing back to work and biomechanical risk assessment
The role of technology for quality and safety in laboratory medicine: the human factors conundrum of the pre-analytical phase and traceability
Resilience in the health care setting

Human Factors and Sustainable Development

ErgoAfrica Symposium: Ergonomics in Africa \" Reality and future perspectives\"

Human Simulation and virtual Environments

Application of Virtual Reality Technologies in Rehabilitation: The current state of the art

Musculoskeletal Disorders

Current Studies on Anthropometric Database and Work-related Musculoskeletal Disorders Prevention in Taiwan

Dose-response relations between physical exposures in the occupational life and low-back outcomes

Evaluation of Job Related Health Hazards of Female Agricultural workers

Field Measurement Exposure With Inertial Sensors

Is it all about posture? A closer look at neck and shoulder MSDs.

Musculoskeletal pain as an outcome – how can we get better insight into the time course of musculoskeletal pain?

On-site interventions for prevention and treatment of Work Related Musculoskeletal Disorders. What works and what doesn't?

Pathophysiology of Musculoskeletal Disorders: Crossing Thresholds

Preventing MSDs among health care workers

Return on Investment for Human Factors / Ergonomics Interventions

Understanding Casual Pathways for Occupational Related Low Back Disorders

Organizational Design and Management

Constructive ergonomics: enabling interventions and related methodological issues

Global Ergonomics Month: Experiences, stories and initiatives around the world

Standarisation in Ergonomics

"24U": THE "PLURIVERSE" DESIGN

Professional Affairs

Professional Ergonomists Education: state of the existing programs

Revising the IEA Core Competencies for Professional Ergonomists

Safety & Health

Coping with complexity and uncertainty: the role of the BRICSplus network in the globalisation of Human Factors and Ergonomics education and training

Development of a compendium of methods for risk assessment of physical workload – A cooperative Project of the German Federal Institute for Occupational Safety and Health (BAuA)

and the German Social Accident Insurance (DGUV)
Objective assessment of physical work exposure: how to measure, analyse and interpret data.
Work With Computing Systems – WWCS
Hermeneut Symposia on Human Factors in Cybersecurity

圖 本次大會在義大利舉行，國內與會專家學者相當多

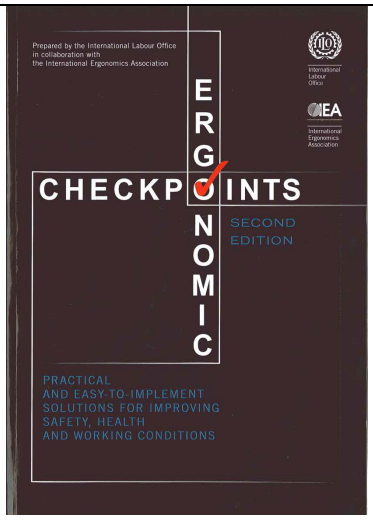
圖 大會開幕

圖 下屆IEA大會於加拿大舉行

大會演講

圖 ILO代表 職業安全衛生專家演講

ILO代表 職業安全衛生專家 Shengli Niu 於大會演講。ILO、IEA雙方在職業安全衛生方面有相當的合作。該專家表示職業傷病所引起的損失，導致很高的社會成本。職業病型態已經從傳統的化學性有機溶劑或毒物等，轉變成現在的社會心理壓力問題與肌肉骨骼傷病。因此，之前ILO與IEA合作編撰之”Ergonomic Checkpoint” 一書，現在是ILO銷售量很多的書籍之一。可見職場肌肉骨骼傷病與危害預防，此一問題受到各界重視。



Ergonomic checkpoint 一書已翻譯成多國語言。中文亦有翻譯本，是一本相當淺顯易懂的書籍。書中將常見的人因工程問題以簡單的檢核方式，介紹危害與改善方式，並以圖例方式呈現。我們下兩頁以checkpoint 5為例，說明工作臺的布置(layout)如何減少勞工搬動物件的負擔，供

	讀者參考。

Figure 5a. Provide stock shelves or racks so that work items coming from one workstation can go directly to the next one.

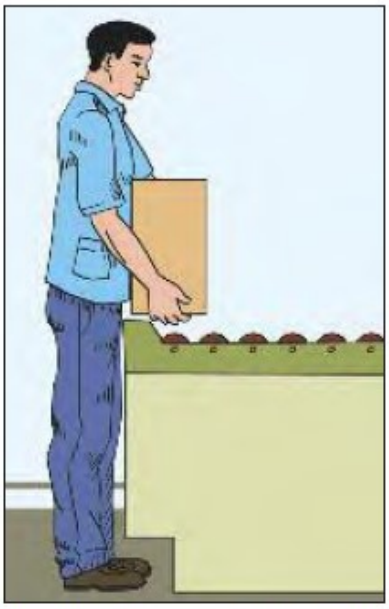


Figure 5b. Rollers or conveyers can reduce the distance materials have to be moved manually. The height should be such that the work item can be handled without bending the upper body. Make sure there is enough space for the feet and body to get close to the rollers or conveyers.

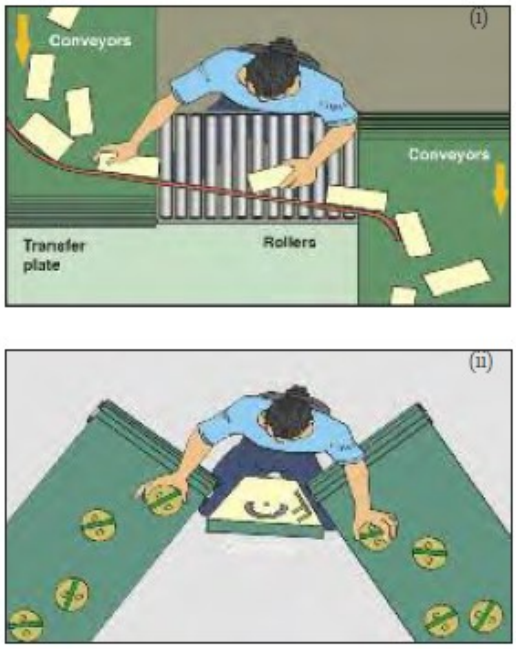


Figure 5c. (i) and (ii) Provide a layout that allows the worker to move objects from one conveyer to the next while keeping a natural posture. Using a transfer plate and rollers makes it easier to move objects.

CHECKPOINT 5

Improve the layout of the work area so that the need to move materials is minimized.

WHY

Machines and workstations are often installed one after another as production expands, and their existing positions are not necessarily suitable for easy and efficient movement of materials. This can be improved by changing their layout.

Time needed to perform a task can be greatly reduced by reducing the movement of materials. This reduces workers' fatigue, allowing more efficient working.

This is also beneficial for preventing accidents caused by moving materials.

RISKS / SYMPTOMS

- physical energy demand
- repetitive strain
- excessive fatigue
- low back pain
- increased injury rates
- stress-induced disorder

HOW

1. Discuss with workers how the frequency and the distance of moving materials can be reduced by changing the layout of machines and workstations. There could be a better way of moving materials within work areas and between different work areas.

2. Arrange a series of several workstations close to one another to minimize the movement of work items between each workstation.

3. Arrange different departments according to the sequence of work done so that work items coming from one department can be utilized by the next without moving them over a long distance.

SOME MORE HINTS

— Use pallets or a batch of work items so that multiple items coming from one workstation can be moved easily to the next workstation or work area.

— Ensure that transport routes are clear when rearranging the layout of the work area.

— A flexible work area layout that can be adapted to changes in work flow (for example, because of product changes or in order to produce several different products) is a productive layout.

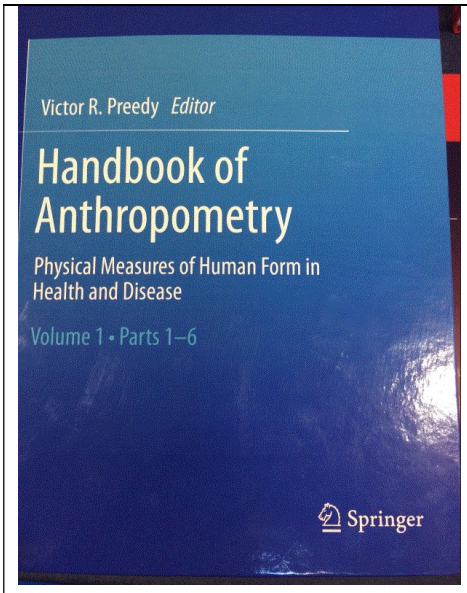
POINTS TO REMEMBER

Minimizing the need to move materials by improving the layout of the work area is the surest way to reduce time and effort, and increase productivity.

大會的研討議題

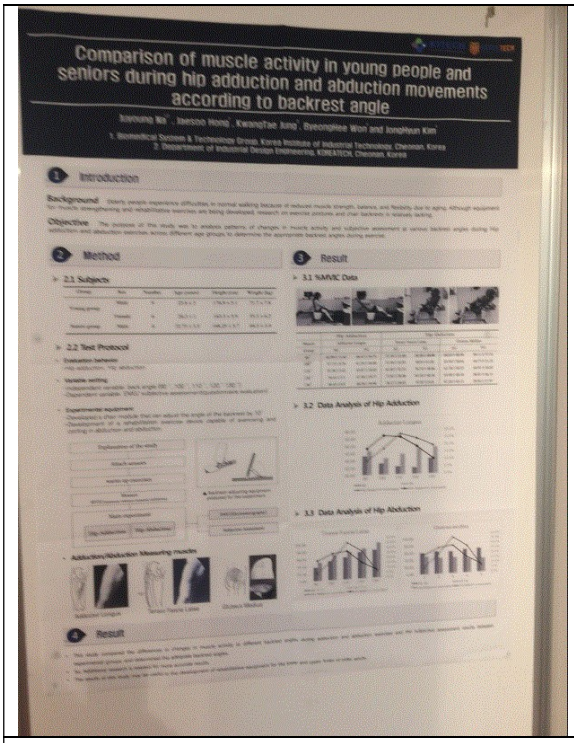
本次大會由於子研討會相當多，以至於同時段之Parallel Sessions 論文很多，列舉如下:

1 人體計測

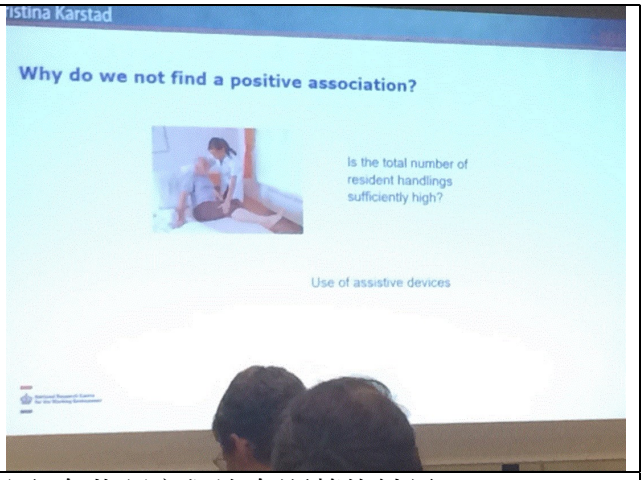
<table>
<tr><td> 
</td><td>人體計測是人因工程研究的基礎資料，世界各國基本上都有其各該國的資料。先進國家甚至定期調查，例如美國、日本、歐盟等。東南亞國家大約在二次大戰前後，也都先後建立自己的人體計測資料。早期人體計測研究非常耗費人力，大部分工作都是人工完成。每一位受測者約有200多個靜態尺寸，100多個動態尺寸。
目前都是使用光學掃瞄儀器，量測非常快速，然而後續的不同角度位置的掃描器資料整合非常耗時。優點是數位化資料，精確度高。我國目前也是運用光學儀器建立人體計測資料。
人體計測資料建立有其標準程序，這部分可以由文獻書籍查詢(如左圖)。</td></tr>
<tr><td>圖 人體計測手冊</td><td></td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>圖 泰國人體計測介紹</td><td>圖 大陸研究人員介紹目前人體計測研究</td></tr>
</table>

2

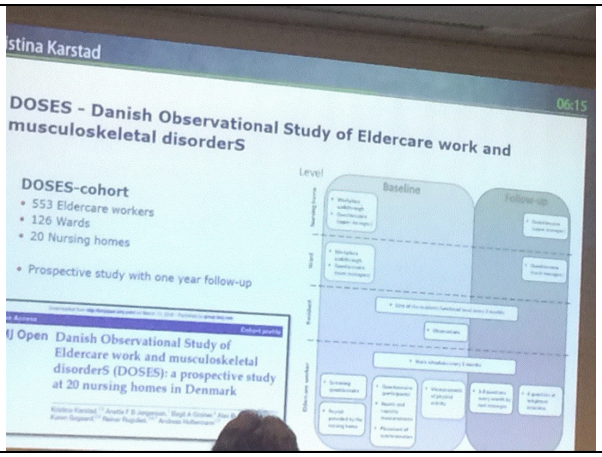
肌肉力量量測

	不同族群例如年輕人、中壯年、高齡人口，或是身障人士等，肌肉力量有顯著差異，活動範圍也是。本篇比較年輕族群與高齡族群髖關節外展與內縮動作之差異。 肌力量測廣義來說也是一種人體計測。往往不同關節、關節角度位置 (或是活動範圍)，受測者所表現出來的肌肉力量不同。因此，工作時或是工具用具的設計，必須考慮此一因素。 例如，高齡者髖關節大腿肌力不足，坐太低的椅子，可能不容易站起來。
圖 比較年輕族群與高齡族群髖關節外展與內縮動作之差異	
	肌力量測也有標準測試方法，包括靜態、動態；等速或等張等等。本篇日本學者以模擬方式探討等長肘屈曲肌力量測與受測者適應時間的影響。 人體肌力除了測量外，建立不同模式或模擬模型，對於後續預測與應用相當重要。透別是數位化時代，建議本所未來也要有這樣的研究規劃，才能發揮影響力與拓展研究成果。
圖 以模擬方式探討等長肘屈曲肌力	

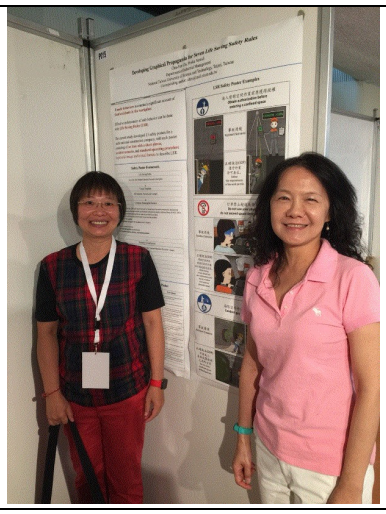
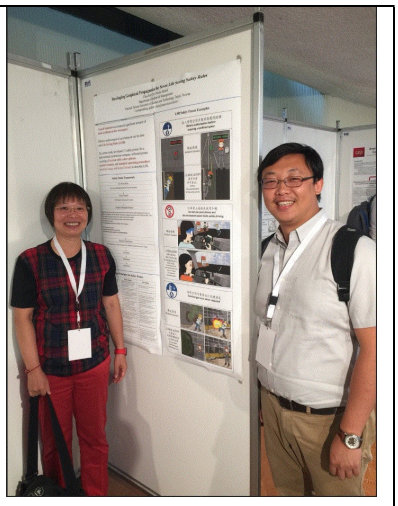
3 照護作業人工搬運

<table>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td>圖 照護人員肌肉骨骼健康與病人搬運。

除了搬運之外，社會心理因素也是影響因子之一。肌肉骨骼傷病的確在文獻上顯示，會受到這兩者的影響。照護作業亦不例外。</td>
<td>圖 有些研究卻沒有顯著的結果

此一作者認為主要是搬運的程度與數量不同。另外，使用輔具的程度與多寡，也是影響因素之一。換言之，多使用輔具可以減少肌肉骨骼傷病。</td>
</tr>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td>圖 本文作者搜尋比較現有研究</td>
<td>圖 丹麥學者以觀察方式探討老人照護作業與肌肉骨骼傷病</td>
</tr>
</table>

大會之海報論文區

本次大會海報論文有400多篇，國內也有多位教授發表。研究範疇包括人機介面、人因工程與設計等。

大會之展示區

	
圖 密西根大學人因工程中心介紹新版關節受力分析軟體	圖 3D人體動態資料擷取系統
	
圖 新型滑鼠測試	圖 復健設備介紹

與外賓交流

1 參與技術委員會(Technical Committee)

本次研討會來自歐美亞非各洲的學者專家非常多，誠如前所言IEA研討會或是組織其實主要是由這些技術委員會運作。研討會各子項會議多數也是技術委員會所規劃。因此，如何針對本所核心工作長期參與這些委員會，除了可以拓展本所知名度外，也可以從技術、研究等方面吸收各國經驗。這些技術委員會除了規畫三年一次的研討會外，期間也會定期開會討論未來研究走向，辦特定研討會交流研究成果，甚至探討國際標準。因此，在人因工程相關的國際標準，往往可以看到這些技術委員會或成員的意見。通常委員會議在晚上舉行，因為研討會往往舉行到傍晚。本次我們參加STF TC，在晚上7點半到9點多，實在有點累。這次討論三個主題:

(1) 下屆2021年IEA研討會，STF子題的議題方向。有人提議除了過往著重在量測技術或標準外，是否增加一些不同領域的應用研究。

(2) 下屆主席(chairperson)合適的人選，此時有加拿大專家提出要求，希望除了學術研究成果外，要是長期經常參與技術委員會的成員。這一部分有一些不同聲音，不再此贅述。

(3) 具有選舉資格的人，這一部分主要是談到出席人員中有些人參與程度不高，是否合適成為具投票的人。

參與委員會需要投入時間人力與預算，我們的研究成果與經驗有機會進一步參與，只要有足夠的經費支持。有一年在美國舉辦滑倒預防的共識會議，邀請我們出席各國一起簽署，但我們沒參加。有一年在日本舉行區域會議，日本願意提供住宿等生活費，但我們沒參加。

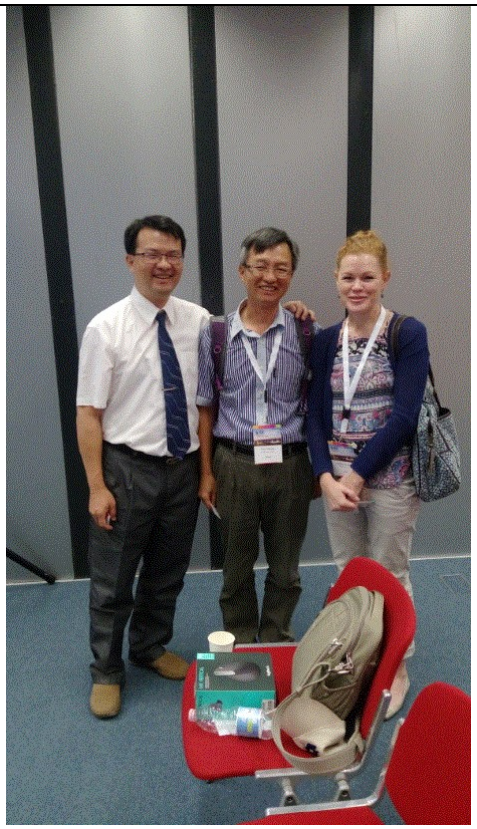
此外，我們與ISO技術委員會生物力學標準專家Aleid Ringelberg交換意見，邀請我們參與下次該委員會議，並提供相關資料給我參考。我們也接觸人體計測技術委員會成員交換意見。

	圖 會後與ISO標準專家 Aleid Ringelberg 交換意見。該專家提供 (1)ISO技術委員會生物力學標準聯絡資訊(如下)；(2)其在該次研討會的簡報供我們參考。

來源:Aleid Ringelberg <aleid.ringelberg@gmail.com>
標題:ISO standards 11228 Manuel handling [加入標籤]
日期:Wed, 29 Aug 2018 18:45:47
附檔:N0xxx_ISO_N0337_CEN_General_presentation.pptx(1258k)
工具選單
純文字 HTML

Dear Sir,
Enclosed you may find a presentation I gave on Monday 27 August at 17.15.
We invite jou to participate in ISO standardisation on biomechanics.
For information you can contact our secretary Ms. Stephanie Jansen at stephanie.jansen@nen.nl or the standardsinstitute in tour country.
Best regards,
Aleid Ringelberg
Convenor ISO TC 159/SC3/WG4 Biomechanics
Netherlands
+31 623366203

---------- Forwarded message ---------
From: **Aleid Ringelberg** <aleid.ringelberg@gmail.com>
Date: zo 26 aug. 2018 21:39
Subject: Fwd: Updated General presentation.pptx
To: j ringelberg <jringelberg@minszw.nl>, Aleid Ringelberg <a.ringelberg@gemeenteraadhillegom.nl>



Dear Mr Chen

It was a pleasure to meet you at the IEA Conference in Florence.
Could you please provide me with Hsin-Hung Tu's email address for future correspondence on head anthropometric data.

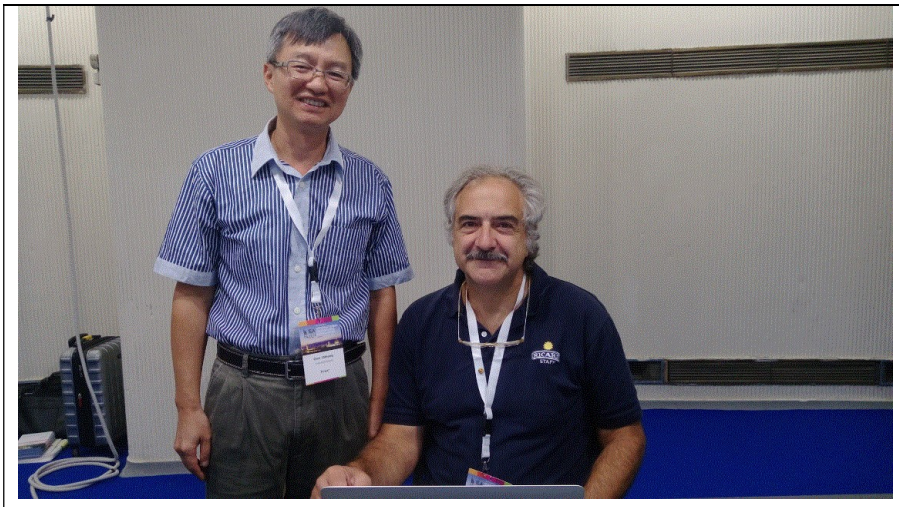
I appreciate your time and efforts,

Best regards,
Karen

圖 上圖左人體計測專家討論我國勞工人體計測研究，上圖右STF技術委員會會場，下圖是該專家希望與我們進一步交換資訊與意見

2 外賓

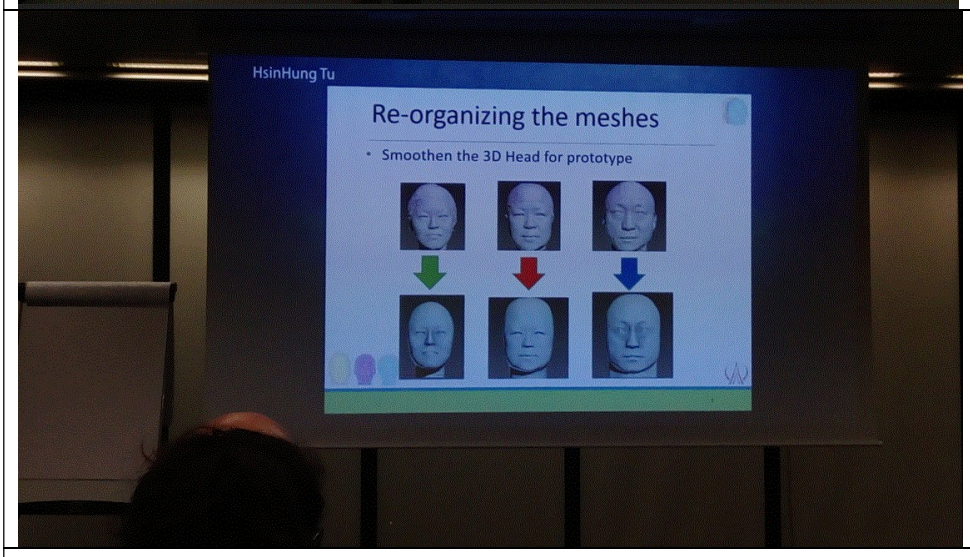
<table>
<tr><td> 
</td><td>圖 本屆 IEA 理事長 是一位日本專家。剛好元智大學周金枚教授是日本留學回來的，透過其介紹，認識主辦本屆大會的理事長</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>圖 我國清華大學王明揚教授是上一屆IEA理事長，如果我們希望多參與IEA，他可以幫忙安排。</td><td>圖 荷 蘭 教 授 Ernst A.P. Koningsceld，前IEA理事長</td></tr>
</table>

	圖 西根大學 Bernard Martin 教授 10多年前拜訪該校時曾參觀 Martin 的實驗室，有關疲勞與人因工程動作負荷的研究
	圖 密西根大學 ergonomic center 技術人員介紹評估軟體使用，此一技術人員長期在實驗室開發與設置實驗所需設施，是該人因中心的重要技術人員。
	圖 新版的3D人體動作關節受力評估軟體，使用者輸入不同的人體計測參數，納入ACGIH的評估，連續video 分析，進化很多


OCCUPATIONAL SAFETY & HEALTH COUNCIL
Dr Alan CHAN Hoi-shou, JP
Chairman
19/F., China United Centre, 28 Marble Road, North Point, Hong Kong SAR, China.
Tel: (852) 2739 9377 Fax: (852) 2116 0393
Email: chairman@oshc.org.hk Website: www.oshc.org.hk
IEA
http://www.iea.cc
Ernst A.P. Koningsveld, Eur.Erg.
Historian
International Ergonomics Association
Human Factors NL, Society of Ergonomics
Laan van Alkemade 5, 2341 LJ. Oegstgeest.
The Netherlands
Tel: +31 629574109
Email: Historian@iea.cc
IEA
MICHIGAN ENGINEERING
UNIVERSITY OF MICHIGAN
Charles Woolley, MS, CPE
Research Area Specialist Lead
Lecturer II
Industrial and Operations Engineering
G624 IOE Building, 1205 Beal Avenue
Ann Arbor, Michigan 48109-2117
T: 734 763-0570 F: 734 764-3451
cwoolley@umich.edu
www.centerforergonomics.org
USA
Ann Arbor
myontec
Janne Pylväs
CEO
Tel: +358 40 507 3979
janne.pylvas@myontec.com
Kuortaneenkatu 2 | FI-00510 Helsinki, FINLAND
www.myontec.com
magic leap
Anthropometry TC
WEAR
Karen Bredenkamp
Senior Human Factors Engineer
7500 W. Sunrise Blvd., Plantation, FL 33322
M 786.778.2003
E kbredenkamp@magicleap.com
Chang WR Falls Prevention, LLC
Wen-Ruey Chang, Ph.D., P.E.
Arlington, VA 22209, USA
Cell (978) 394-3370
wenruey.chang@outlook.com
www.changwr.com
IEA
http://www.iea.cc
藤田祐志
Dr. Yushi Fujita, CPE, CPE-J
President
International Ergonomics Association
Japan Ergonomics Society
Postal Address: Mita 4-8-38, Minato-ku
Tokyo 108-0073, Japan
Mobile: +81-80-8497-1870
Fax: +81-3-3441-8774
Email: President@iea.cc, yushi1130@gmail.com
IEA

圖 外賓聯繫資訊

二、論文發表



Development of Standard 3D Human Heads of Taiwanese Laborers for Respiratory Mask

Development of Standard 3D Human Heads of Taiwanese Laborers for Respiratory Mask

HsinHung TU[1], ChihYong Chen[2]
[1]Department of Industrial Engineering and Management, Hsiuping University of Science and Technology
2Institute of Labor, Occupational Safety and Health, Ministry of Labor

Abstract

The purpose of this study is to develop a set of Taiwanese laborers' standard 3D human heads for respiratory mask. A Taiwanese Laborers' 3D Human BodyBank was used in this study. This 3D Human BodyBank was consisted of 3D range data of 488 subjects (244 males and 244 females) recruited from laborer populations in manufacturing industries in Taiwan. 3D human heads were extracted from this 3D Human BodyBank. For the design of respiratory masks, face length (Menton-subnasal length) and face breadth (bi-zygomatic breadth) were then extracted from each 3D human head. A set of three 3D human heads were selected as representations of the norms of the small (S), medium (M), and large (L) size groups. These three sizes intended to fit as best as possible to the subject population. These three 3D human heads were processed by sizing and selection phases. The sizing phase was to divide the whole sample set into three size groups by optimizing the dispersion of the face length and face breadth against allowable design tolerance. The selection phase was to select a "typical model" withineach size group using difference analysis algorithm. The typical model was the one with the smallest difference value within the group, and taken as the standard one of the group. The resultant three size groups covers 90.37% of the population. The three standard 3D human heads were also compared with the ones in previous studies in Taiwan.

Keywords: 3D Anthropometry, Human Head, Respiratory, Taiwanese

The Friction Requirement for Different Body Mass Index of Workers under Various Loadings

Ching-Chung Chen[1], Zhi-Xuan Chen[2], Chih-Lin Chang[3], Liwen Liu[4]
[1,2]Hsing Wu University of Science and Technology
[3]Hsiuping University of Science and Technology
[4]Institute of Labor, Occupational Safety and Health, Ministry of Labor

Abstract

Slipping & falling Incidences are common. They create serious occupational safety & health problems. In addition to workplace safety, slipping & falling also happens in our daily life and leisure activities. The opportunities of slipping & falling are decided by whether the required coefficient of friction (RCOF) is larger than the available coefficient of friction (ACOF). When RCOF is larger than ACOF, the slipping & falling will occur. Therefore, the ACOF should be seen as a basic value of deciding whether the slipping & falling happen and RCOF can be calculated by the normal force of feet produced during walking or performing activities on the floor. Gait experiments are normally conducted to analyze the risk of slip & fall. However, the speed of pace, the degree of lading and the body mass index (BMI) are also the factors influencing slipping & falling. At work places, the workers normally have different BMI and those workers perform carrying with load which easily cause slips/falls. Therefore, this study discussed RCOF with different degrees of load and BMI to evaluate the risks of slips/falls. The results found out the speed of pace does not significantly ($p>0.05$) affect the RCOF; however, the RCOF is significantly ($p<0.05$) influenced by the level of lading, BMI and ACOF. The results also indicated that the RCOF with load carrying is significantly ($p<0.05$) higher than the RCOF with load carrying; however, the differences of RCOF between various load carrying situations are not significant ($p>0.05$). RCOF for workers who is overweight is significantly ($p<0.05$) higher than RCOF for those are normal weight and lightweight. RCOF is positively correlate to ACOF.

Keywords: Required Coefficient of Friction, Available Coefficient of Friction, Speed of Pace, The Degree of Lading, The Body Mass Index

參、心得與建議

1. 綜觀本次研討會的論文發表與專題，可以發現目前人因工程研究的概況與未來新趨勢。個人歸納為三大方向:

   (1) 傳統人因工程研究，例如人體計測、肌肉骨骼傷病危害因子評估技術、人因工程與設計等；

   (2) 應用人因工程於其他領域，例如國防工業或作業、病人安全、照護作業等；

   (3) 結合新科技，例如人工智慧、機器人、自動車。

2. 本次研討會70多國近2000人與會，包括ILO代表。可見IEA研討會受到各國專家學者重視。因此，參與IEA研討會發表本所研究成果，是一種與各國專家接觸交流的好機會，也可以掌握新儀器設備與研究發展趨勢。

3. 我國人因工程學會(EST)與IEA有相當關係，例如上一屆IEA理事長就是我國EST的理事長。而本所也累積多年研究成果，足以參與更多IEA的工作。例如本次我們參加滑跌倒墜落 STF TC 技術委員會。與ISO技術委員會生物力學標準專家Aleid Ringelberg交換意見，邀請我們參與下次該委員會議，並提供相關資料給我參考。我們也接觸人體計測技術委員會成員交換意見。