

*Advances in
Physical Ergonomics
and
Human Factors*

Part I

Advances in Human Factors and Ergonomics 2014

5th International Conference on Applied Human Factors and Ergonomics

20 Volume Set: Proceedings of the 5th AHFE Conference 19-23 July 2014

<i>Advances in The Human Side of Service Engineering</i>	<i>Louis Freund and Wojciech Cellary</i>
<i>Advances in Human Factors and Sustainable Infrastructure</i>	<i>Jerzy Charytonowicz</i>
<i>Advances in Human Aspects of Healthcare</i>	<i>Vincent Duffy and Nancy Lightner</i>
<i>Advances in Applied Digital Human Modeling</i>	<i>Vincent Duffy</i>
<i>Advances in Cross-Cultural Decision Making</i>	<i>Sae Schatz, Joseph Cohn and Denise Nicholson</i>
<i>Advances in Human Factors, Software, and Systems Engineering</i>	<i>Ben Amaba and Brian Dalgetty</i>
<i>Advances in Human Aspects of Transportation (Part I, II, III)</i>	<i>Neville Stanton, Steve Landry Giuseppe Di Bucchianico and Andrea Vallicelli</i>
<i>Advances in Safety Management and Human Factors</i>	<i>Pedro Arezes and Paulo Carvalho</i>
<i>Advances in Cognitive Engineering and Neuroergonomics</i>	<i>Kay Stanney and Kelly Hale</i>
<i>Advances in Social and Organizational Factors</i>	<i>Peter Vink</i>
<i>Advances in The Ergonomics in Manufacturing: Managing the Enterprise of the Future</i>	<i>Stefan Trzcielinski and Waldemar Karwowski</i>
<i>Advances in Physical Ergonomics and Human Factors (Part I, II)</i>	<i>Tareq Ahram and Renliu Jang</i>
<i>Advances in Ergonomics In Design, Usability & Special Populations (Part I, II, III)</i>	<i>Marcelo Soares and Francisco Rebelo</i>
<i>Advances in Affective and Pleasurable Design</i>	<i>Yong Gu Ji and Sooshin Choi</i>
<i>Advances in Science, Technology, Higher Education and Society in the Conceptual Age: STHESCA</i>	<i>Tadeusz Marek</i>

*Advances in
Physical Ergonomics
and
Human Factors
Part I*

*Edited By
Tareq Ahram
and
Renliu Jang*

Published by AHFE Conference © 2014

Published by AHFE Conference © 2014

No claim to original U.S. Government works

Printed in the United States of America on acid-free paper

Version Date: 20140710

International Standard Book Number: 978-1-4951-2104-3 (Hardback)

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, please access (<http://www.copyright.com/>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Visit the AHFE Web site at
<http://www.ahfe.org>

Table of Contents

Section 1: Safety Management Systems

The interrelationship between quality production and safety in factories S. Markulik, L. Kamenicky, J. Namešanska and A. Nagyova, Slovakia	3
Integrated security or selective risk assessment? J. Sinay, A. Tompos, S. Vargova and F. Kalafut, Slovakia	9
Influence of physical properties of concrete on operator's exposure to noise and hand-transmitted vibration S. Fiserova, Czech Republic	16
System of lifelong learning in occupational safety and health in the Slovak Republic T. Kozik, I. Turekova, R. Bulla and T. Bagalova, Slovakia	24
Workplace lighting as an element influencing the working process I. Turekova, T. Kozik, T. Bagalova, and J. Neovesky, Slovakia	34
The role of human factor in the transport of hazardous materials S. Bęczkowska, I. Grabarek and W. Choromanski, Poland	44
Study on safe activity activation based on the attitude survey about the safe activity of the employee T. Oikawa and Y. Okada, Japan	54

Section 2: Physical Ergonomics and Human Interactions

The ergonomics of interactive and stereoscopic 3D product models for design education L.-C. Chen, P.-Y. Chu and Y.-M. Cheng, Taiwan	69
"Will use it, because I want to look cool." A comparative study of simple computer interactions using touchscreen and in-air hand gestures V. Vaidyanathan and D. Rosenberg, USA	76
Evaluation of endpoint compliance based on the estimation of the muscle activity Y. Kurita, K. Sakurada and T. Tsuji, Japan	89
Effects of personalized environmental control (PEC) on user comfort, health and typing performance A. Hedge, USA	92

Section 3: Workload and Stress Assessment in Complex Systems

Experimental study of task load measurement for basic flight operation task L. Wang, X. He, Y. Wang and Y. Chen, China	107
Probe into the methods of flight training based on special flight environment X. Zhao, Y. Li, L. Ding, L.-D. Zhang, W.-B. Zhang and Z.-W. Zhu, China	115
Workload assessment for manual and automated processes in life sciences M. Swangnetr, Germany/Thailand, D. Kaber, USA, E. Vorberg, H. Fleischer and K. Thurow, Germany	121
The treatment performances of smart healthcare clothing system based on U-computing using transcutaneous electrical nerve stimulator for the hypertensive R.-H. Kim, S. Korea	129

Section 4: Ergonomic Analysis

Self-adaptive blur: A persuasive method for healthy posture Y. Liu, C. Liao and J. Zhang, P.R. China/USA	142
Ergonomic analysis of rice basketwork N. Rodjanapanurat, O. Buranruk, P. Wongchai and K. Wongwilairat, Thailand	150
Effect of time of day and treadmill running on the vertical spinal creep response R. Puntumetakul, U. Karukunchit, M. Swangnetr and M. Puntumetakul, Thailand	157
A study of the impulse noise for the protecting earplug performance S. Chung and H. Yun, Korea	168
Error analysis for three-dimensional anthropometric survey of young Chinese males X. Zhang, X. Zheng, S. Ding, T. Liu and H. Fang, China	173
Development of BAC consumption and related structure equation model on Korean driver S. Chung, Korea	177

Section 5: Safety Management Systems

Risk assessment for LPG storage A. Bernatik and I. Bartlova, Czech Republic	186
--	-----

RBI - support tool for industry risk prevention H. Pacaiova, M. Oravec and J. Kolesar, Slovakia	194
Method for fidelity evaluation of nuclear power plant simulators from the human factors point of view J. Laarni and H. Koskinen, Finland	202
A system for automated live ergonomics assessment and its applications in manufacturing T. Nguyen, M. Kleinsorge and J. Kruger, Germany	211
Safety assessment of pesticide-barrier protection properties of high-tech material agricultural safety clothing: In vivo-test using the artificial skin R.-H. Kim and S.-S. Choi, S. Korea	222

Section 6: Work-Physiological Approaches in Physical Ergonomics

Rollermouse vs. standard computer mouse – Electromyographic and subjective assessment of the usability in applications with graphical user interfaces K. Kluth and E. Keller, Germany	235
Assessment of the ergonomic quality of European screwdrivers M. Penzkofer, A. Henke and K. Kluth, Germany	247
Ergonomic evaluation of pressure limits for the fire water supply for physically feasible and safe indoor fire-fighting S. Groos and K. Kluth, Germany	259
Physical strength and hand dimensions of population sample: Results and differences in age and gender A. Klussmann, C. Muehlemeyer, P. Serafin, I. Levchuk, K. Lang and H. Gebhardt, Germany	270
Anthropometric considerations for designing a test finger to avoid electrical and mechanical hazards H. Gebhardt, C. Muehlemeyer, K. Lang, B. Schlutter and A. Vomberg, Germany	277
Physical stress and disorders of the hand-arm system at construction workers B. Hartmann, Germany	285
Advances in human strength measurement and modeling in workspace B. Das, Canada	292
Development and validation of a posture driven tool to estimate the hazards of manual lifting S.-Y. Lu, Y.-S. Ing, C.-L. Lee and Y.-T. Pan, Taiwan	299

Section 7: Work-Related Musculoskeletal Disorders (WMSD) Prevention

Trends in management of risks associated to biomechanical overload based on new ISO technical report E. Occhipinti and D. Colombini, Italy	311
A simple tool for preliminary hazard identification and quick assessment: Applicative experiences J.-J. Atain-Kouadio, L. Claudon, P. Maziere, J.-P. Meyer, F. Navier, J. Parachini, E. Turpin-Legendre, J.-J. Verdebout and J.-P. Zana, France	321
The study of work situations with exposure to multiple tasks in annual cycle: Practical experiences in the field D. Colombini and E. Occhipinti, Italy	324
Prevention of WMSDs from biomechanical overload in agriculture: A project by Italian regions G. Di Leone, A. Del Rosso and F. Longo, Italy	337

Section 8: Physical Hazard and Prevention

Effects of game-setting on wrist motion and muscle fatigue R.-L. Jang and F. Sung, Taiwan	347
Medicine slips prevention for patient safety C.-W. Lu, Taiwan	352
Effects of different surfaces on biomechanical loading of the upper extremities while handling wheelbarrows Y.-H. Lin, Taiwan	358
Usability evaluation for driving with the joystick and mechanical hand controllers H.-C. Wu, C.-T. Lin, M.-C. Chiu and Y.-C. Lin, Taiwan	365
Investigating the enhancement of stereoscopic displays to parking performance A.-C. Chen and C.-C. Chen, Taiwan	370
Quantitative assessment of computer inputs and musculoskeletal complaints among three workgroups H.-C. Chen, Y.-W. Chen, Y.-P. Liu and T.-T. Pan, Taiwan	375
Cell phone conversations with hands-free devices interfering with cognition of visual information while driving A. Takano, H. Nishiguchi and M. Karashima, Japan	384

Factors associated with spinal disorders among visual display unit
workers

395

K. Takekewa, J. Goncalves, F. Foltran, C. Moriguchi, A. Oliveira and T.
Sato, Brazil

Preface

The discipline of human factors and ergonomics (HF/E) is concerned with the design of products, process, services, and work systems to assure their productive, safe and satisfying use by people. Physical ergonomics involves the design of working environments to fit human physical abilities. By understanding the constraints and capabilities of the human body and mind, we can design products, services and environments that are effective, reliable, safe and comfortable for everyday use.

A thorough understanding of the physical characteristics of a wide range of people is essential in the development of consumer products and systems. Human performance data serve as valuable information to designers and help ensure that the final products will fit the targeted population of end users. Mastering physical ergonomics and safety engineering concepts is fundamental to the creation of products and systems that people are able to use, avoidance of stresses, and minimization of the risk for accidents.

This book focuses on the advances in the physical HF/E, which are a critical aspect in the design of any human-centered technological system. The ideas and practical solutions described in the book are the outcome of dedicated research by academics and practitioners aiming to advance theory and practice in this dynamic and all-encompassing discipline.

A total of seventeen sections presented (eight sections in Part I and nine sections in Part II). Each section contains research that have been reviewed by members of the International Editorial Board. Our sincere thanks and appreciation to the Board members as listed below:

F. Aghazadeh, USA	S. Maly, Czech Republic
M. Boocock, New Zealand	J. Niu, China
E. Cadavid, Colombia	I. Noy, USA
J. Callaghan, Canada	E. Occhipinti, Italy
P. Dempsey, USA	Y. Okada, Japan
R. Feyen, USA	H. Pacaiova, Slovak Republic
R. Goonetilleke, Hong Kong	Z. Roja, Latvia
J. Grobelny, Poland	K. Saarela, Finland
J. James, South Africa	L. Saenz, Colombia
R. Jang, Taiwan	J. Sinay, Slovak Republic
Y. Kwon, Korea	H. Strasser, Germany
M. Lehto, USA	S. Vlkova, Czech Republic
L. Ma, China	T. Waters, USA

We hope that this book, which is the international state-of-the-art in physical domain of human factors, will be a valuable source of theoretical and applied knowledge enabling human-centered design of variety of products, services and systems for global markets.

July 2014

Tareq Ahram
University of Central Florida
Orlando, Florida, USA

Ren-Liu Jang
Ming Chi University of Technology
Taipei, Taiwan

Editors