

Proceedings of the International Conference on

3D Body Scanning Technologies

Lugano, Switzerland, 19-20 October 2010

Editor and Organizer

Hometrica Consulting - Dr. Nicola D'Apuzzo Switzerland www.hometrica.ch



This compilation © 2010 by Hometrica Consulting - Dr. Nicola D'Apuzzo, Switzerland. Reproduction of this volume or any parts thereof (excluding short quotations for the use in the preparation of reviews and technical and scientific papers) may be made only after obtaining the specific approval of the publisher. The papers appearing in this volume reflect the author's opinions. Their inclusion in this publication does not necessary constitute endorsement by the editor or by the publisher. Authors retain all rights to individual papers.

ISBN 978-3-033-02714-5

Published by

Hometrica Consulting - Dr. Nicola D'Apuzzo Culmannstrasse 59, CH- 8006 Zurich, Switzerland Tel: +41 44 362 3297

Email: info@hometrica.ch Web: www.hometrica.ch

Table of contents

Introduction	9	
Opening Session	pag.	paper#
Relating Linear and Volumetric Variables through Body Scanning to Improve Human Interfaces in Space Sarah MARGERUM ^{a,d} , Mike FERRER ^{b,d} , Karen YOUNG ^{a,d} , and Sudhakar RAJULU ^{c,d} ^a Lockheed Martin, Houston (TX), USA; ^b MEI Technologies Inc., Houston (TX), USA; ^c National Aeronautics and Space Administration, Johnson Space Center, Houston (TX), USA; ^d Anthropometry and Biomechanics Facility, Johnson Space Center, Houston (TX), USA	10	#15
Technical Session 1: Medical scanning systems	pag.	paper#
Application of Stereo Photogrammetry in Medicine Chris LANE 3dMD, Atlanta, USA	23	#60
The Innovative 3D Spine Form Analysis and Parametrization of Scoliosis, Lordosis, Kyphosis and Malposition with TERGOSKOP Lothar PAUL ^a , Heiko TOBER ^b , Günther HEGEWALD ^b ^a Gesellschaft zur Förderung angewandter Informatik e.V. Berlin (GFal), Berlin, Germany; ^b T&T medilogic GmbH Berlin, Germany	24	#03
3D Digitizing Device Applied in Evaluation and Simulation of Postoperative Trunk Surface Shape in Adolescent Idiopathic Scoliosis Farida CHERIET ^{a,c} , Li SONG ^b , Philippe DEBANNÉ ^{a,c} , Olivier DIONNE ^a , Hubert LABELLE ^{c,d} ^a Department of Computer Engineering, École Polytechnique de Montréal, Montréal (QC), Canada; ^b Creaform Inc., Lévis (QC), Canada; ^c Research Center, CHU Sainte-Justine, Montréal (QC), Canada; ^d Department of Surgery, Faculty of Medicine, Université de Montréal, Montréal (QC), Canada	33	#52
Optical 3D in Vivo Skin Imaging for Topographical Quantitative Assessment of Cosmetic and Medical Treatments S. Christian BENDEROTH, Rolf HAINICH GFMesstechnik GmbH, Teltow, Germany	42	#29
3D Face Measurement and Scanning Using Digital Close Range Photogrammetry: Evaluation of Different Solutions and Experimental Approaches Luigi Maria GALANTUCCI, Fulvio LAVECCHIA, Gianluca PERCOCO Politecnico di Bari, Italy	52	#34
Technical Session 2: Body Scanning for Apparel I	pag.	paper#
Perfect Garment Fitting Using 3D Body Scanning Ran MACHTINGER OptiTex Ltd, Israel	59	#40
The Solution of a Clothing Mass Customization Program Jocelyn BELLEMARE Ecole Polytechnique of Montreal, Departement of Industrial Engineering, Montreal (QC), Canada	60	#43
Three Dimensional (3D) Body Scanner for Apparel Shoppers Would Make Commerce Easier Marie-Eve FAUST ^{a*} and Serge CARRIER ^b ^a Fashion Merchandising, School of Business Administration, Philadelphia University, USA ^b Département de management et de technologie, Université du Québec à Montréal, Canada	68	#53

Made-to-Measure Garments in 3-D Jochen BALZULAT ^a , Wolfgang SEEBAUER ^b ^a Human Solutions GmbH, Kaiserslautern, Germany; ^b Odermark Bekleidungswerke Brinkmann GmbH & Co. KG, Northeim, Germany	77	#61
Technical Session 3: Medical Applications I	pag.	paper#
Three-Dimensional Surface Imaging - an Abjective Approach of Quality Assurance in Facial Plastic, Reconstructive and Aesthetic Surgery? Laszlo KOVACS, Fee ARMBRECHT, Stefan RAITH, Alexander VOLF, Nikolaos A. PAPADOPULOS, and Maximilian EDER	82	#23
Research Group Computer Aided Plastic Surgery - CAPS, Clinic for Plastic Surgery and Hand Surgery, Technical University Munich, Germany		
Computer-Assisted Intuitive Breast Surgery Planning Using Three-Dimensional Surface Imaging Laszlo KOVACS, Fee ARMBRECHT, Stefan RAITH, Alexander VOLF, Nikolaos A. PAPADOPULOS, and Maximilian EDER	84	#22
Research Group Computer Aided Plastic Surgery - CAPS, Clinic for Plastic Surgery and Hand Surgery, Technical University Munich, Germany		
3D in Forensics: TIM Synthetic MRI and Virtobot — Forensic Workflow of the Future Michael THALI University Forensic Institute Bern (IRM), Center Forensic Imaging and Virtopsy, Bern, Switzerland	86	#51
Optimization of Three-Dimensional Imaging of the Breast Region with 3-D Laser Scanners Maximilian EDER**, Fee ARMBRECHT*, Stefan RAITH*, Alexander VOLF*, Alexander ZIMMERMANN*, Nikolaos A. PAPADOPULOS*, and Laszlo KOVACS*	87	#21
^a Research Group Computer Aided Plastic Surgery - CAPS,Clinic for Plastic Surgery and Hand Surgery, Technical University Munich, Germany; ^b Clinic for Vascular Surgery, Technical University Munich, Germany		
Technical Session 4: Body Scanning for Apparel II	pag.	paper#
Apparel: from Reality to Virtual Reality Jean-Marc SURVILLE Lectra, France	89	#41
Research in Body/Garment Relationships Susan P. ASHDOWN ^a , Catherine DEVINE ^a , Paul D. ERICKSON ^b ^a Department of Fiber Science & Apparel Design, Cornell University, Ithaca (NY), USA ^b Department of Learning Strategies, Cornell University, Ithaca (NY), USA	96	#16
Quantitative Analysis of the Air Gap between the Skin and the Clothing Joanna FRACKIEWICZ-KACZMAREK, Agnes PSIKUTA, Renè M. ROSSI EMPA, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Protection and Physiology, Sankt Gallen, Switzerland	107	#38
Quantitative Analysis of Breast Shapes Rong ZHENG ^{a,b} , Winnie YU ^a , Jintu FAN ^a ^a Institute of Textiles and Clothing, Hong Kong Polytechnic University, Kowloon, Hong Kong; ^b Aimer Human Engineering Research Centre, Beijing Institute of Fashion Technology, Beijing, China	113	#46

Technical Session 5: Foot Scanning	pag.	paper#
ERTLRENZ Experiences from Scaling Up a Shop-in-Shop System for Mass Customized High Performance Sports Shoes Sven RENZ ^a , Dirk RUTSCHMANN ^b , René PFEIFFER ^b , Florian WILD ^b * ERTLRENZ GmbH, Germany * corpus.e AG, Germany (#07)	120	#07
Recommendation System for Sizing of Children's Footwear Tomaž KOLŠEK, Aleš JURCA, Tina VIDIĆ UCS d.o.o., Vrhnika, Slovenia	126	#49
Design Criteria for Combat Boots Based on the Evaluation and Analysis of Human Factors Laura Lucía PEREZ, Ana María POLANCO, Alejandro MARANON Department of Mechanical Engineering, Universidad de los Andes, Bogota, Colombia	132	#47
Laser Based Three-Dimensional Measurement of Entire Foot Shape During Motion Matija JEZERŠEK, Janez MOŽINA Faculty of Mechanical Engineering, University of Ljubljana, Slovenia	141	#28
Technical Session 6: Full Body Scanning	pag.	paper#
3-D Photonic Scanning for Health Research and Practice Jonathan WELLS ^a , Tony RUTO ^b , Lewis GRIFFIN ^b , and Philip TRELEAVEN ^b ^a Childhood Nutrition Research Centre, Institute of Child Health, UCL, London, UK; ^b Department of Computer Science, UCL, London, UK	146	#06
The Body Volume Index (BVI): Using 3D Scanners to Measure and Predict Obesity Richard BARNES Select Research Ltd., Birmingham, UK	147	#13
An Overview of 3D Body Scanning Applications in Thailand Supiya CHAROENSIRIWATH and Chularat TANPRASERT Knowledge Elicitation and Archiving Laboratory (KEA), National Electronics and Computer Technology Center (NECTEC), Pathumthan, Thailand	158	#27
Mass Implementation of 3D Body Scanners for Human Body Measurement for Applications in Apparel, Fashion, Anthropometrics, Health, Fitness and Entertainment David BRUNER [TCf², Textile/Clothing Technology Corp., Cary (NC), USA	166	#55
Technical Session 7: Medical Applications II	pag.	paper#
3D Optical Body Scanning: Application to Forensic Medicine and to Maxillofacial Reconstruction Gianluca CAVAGNINI, Giovanna SANSONI, Angelo VERTUAN and Franco DOCCHIO Laboratory of Optoelectronics, University of Brescia, Italy	167	#33
Breast Volume Measurements Using 3-D Surface Imaging: a Standardized Validation of the Introduced Method and a Comparison to Classical Approaches Stefan RAITH, Maximilian EDER, Fee ARMBRECHT, Alexander VOLF, and Laszlo KOVACS Research Group Computer Aided Plastic Surgery - CAPS, Clinic for Plastic Surgery and Hand Surgery, Technical University Munich, Germany	179	#12

3D-Sensors for the All-Around Measurement of Teeth, Skin, Face, and Body	181	#63
Gerd HÄUSLER ^{a,b} , Klaus VEIT ^a ^a 3D-Shape GmbH, Erlangen, Germany, ^b Institute of Optics, University Erlangen, Erlangen, Germany		
Objective 3-D Breast Symmetry Evaluation For Clinical Application Using Three-Dimensional Laser Light Surface Imaging Fee ARMBRECHT ^a , Maximilian EDER ^a , Stefan RAITH ^a , Alexander VOLF ^a , A. SWOBODNIK ^a , AK. PAPE ^a , T. SCHUSTER ^b , Nikolaos. A. PAPADOPULOS ^a , HG. MACHENS ^a , and Laszlo KOVACS ^a Research Group Computer Aided Plastic Surgery - CAPS, Clinic for Plastic Surgery and Hand Surgery, Technical University Munich, Germany; ^b Institute of Medical Statistics and Epidemiology, Technical University Munich, Germany	184	#26
Integrated 3D Body Scanner with Real-Time Compensation of Breathing Movement Artifacts Paolo PATETE, Marco RIBOLDI, Guido BARONI Bioengineering Department, Politecnico di Milano, Milan, Italy	185	#65
Technical Session 8: Body Scanning Systems	pag.	paper#
A Portable 3D Body Scanner Hideto KAMESHIMA ^a , Yuji NISHIO ^a , Yukio SATO ^{a,b} ^a Spacevision, Shibuya (Tokyo), Japan; ^b Keio University, Yokohama (Kanagawa), Japan	191	#09
Optical Measurement of Preselected Individual Body Parameters, 3D Curves and Belt Position for Garment Manufacturing and Sales with BodyFit 3D Lars KUNZE, Niels HEUWOLD, Lothar PAUL GFal, Gesellschaft zur Förderung angewandter Informatik e.V. Berlin (GFal), Germany	197	#02
Challenges and Solutions in High Resolution Human Body Scanning Aivaras GRAUZINIS 4DDynamics, 's Gravenwezel, Belgium	206	#45
Body-ScanFit System Leonardo FRANCESCHI Cad Modelling Ergonomics s.r.l., Florence, Italy	207	#56
New Age Human Body Digitizing: Easy, Portable, Quick Sergey SUHOVEY Artec Group Inc., San Diego (Ca), USA	212	#62
Technical Session 9: Face Scanning	pag.	paper#
A Computer-Aided Technique for Planning Plastic Surgery Based on 3D Face Scans: Preliminary Results Andrea BOTTINO, Matteo DE SIMONE, Aldo LAURENTINI Dipartimento Automatica e Informatica, Politecnico di Torino, Turin, Italy	213	#54
A Simple and Standardized Method for Analyzing Head and Face Morphology of a Population Sample Yohann KELKEL, Matthieu FOISSAC, Laurent BALY Oxylane research, Decathlon SA, Villeneuve d'Ascq, France	222	#44
An Open Platform for 3D Face Recognition Algorithms Hassen DRIRA ^a , Boulbaba BEN AMOR ^{b,a} , Mohamed DAOUDI ^{b,a} , Anuj SRIVASTAVA ^c , and Joseph COLINEAU ^d ^a LIFL (UMR CNRS 8022), Université de Lille1, France; ^b Institut TELECOM, TELECOM Lille 1, France; ^c Departement of Statistics, FSU, Tallahassee (FL), USA; ^d THALES-TRT, Palaiseau, France	229	#48

Three-Dimensional Features for Facial Gestures Simulation Javier FINAT ^a and Antonio HURTADO ^b ^a Computer Science Engineering, University of Valladolid, Spain ^b MoBiVAP R&D Group, University of Valladolid, Spain	237	#19
Technical Session 10: Digital Anthropometry	pag.	paper#
HOAXY Body Shapes and Fashion Formula Jean-Marc SURVILLE ^a , Sonia HERICHI ^b ^a Lectra, France ^b Victor Segalen Bordeaux University, France	249	#39
3D Digital Anthropometry Using the BodySCAN Christian LOVATO ^a , Chiara MILANESE ^{a,b} , Andrea GIACHETTI ^c , Carlo ZANCANARO ^{a,b} ^a Dept. of Neurological, Neuropsychological, Morphological and Movement Sciences, University of Verona, Italy; ^c Department of Informatics, University of Verona, Italy	259 a, Italy;	#05
An Introduction to BoSS-21 and a Framework to Build 3D Surface of Human Models Using Anthropometric Constrains Shi YIN, Rachida AMJOUN, Ali AVANNAKI Vislmage Systems Inc., Toronto, Canada	264	#14
iSize - Implementation of International Anthropometric Survey Results for Worldwide Sizing and Fit Optimization in the Apparel Industry Anke RISSIEK, Rainer TRIEB Human Solutions GmbH, Kaiserslautern, Germany	269	#64
Technical Session 11: Scanning Technologies	pag.	paper#
Scanner Killer Technology - One Scanner to Rule them All Helmut KUNGL XYZ RGB Inc., Ottawa, Canada	282	#59
"Flying Triangulation" – Acquiring the 360° Topography of the Human Body on the Fly Svenja ETTL, Oliver AROLD, Florian WILLOMITZER, Zheng YANG, Gerd HÄUSLER Institute of Optics, Information, and Photonics, University Erlangen-Nuremberg, Germany	283	#42
Photogrammetric 3D Body Scanner for Low Cost Textile Mass Customization Gianluca PERCOCO and Luigi M. GALANTUCCI Politecnico di Politecnico di Bari, Italy	289	#10
Design of a Passive System for Human Body Reconstruction in the Fashion Industry Gianfranco FORLANI ^a , Carla NARDINOCCHI ^b , Riccardo RONCELLA ^a Department Civil Engineering, University of Parma, Italy Department I. C. E. A., University of Rome 'Sapienza', Italy	296	#30
Technical Session 12: Anthropometric Survey	pag.	paper#
Anthropometric Survey of the Spanish Female Population Aimed at the Apparel Industry Sandra ALEMANY ^a , Juan Carlos GONZÁLEZ ^a , Beatriz NÁCHER ^a , Carol SORIANO ^a , Carlos ARNÁIZ ^b , and Ángeles HERAS ^b ^a Instituto de Biomecánica de Valencia, Spain; ^b Instituto Nacional de Consumo, Madrid, Spain	307	#11

Analysis of 3D Body Scanning for Body Measurement Extraction Considering the Cultural Context Arzu VURUSKAN ^{a,b} , Ender BULGUN ^b ^a Department of Fashion Design, Izmir University of Economics, Izmir, Turkey; ^b Department of Textile Engineering, Dokuz Eylül University, Izmir, Turkey	316	#20
UK National Sizing Survey – SizeUK Jennifer BOUGOURD and Philip TRELEAVEN University College London, UK	327	#32
DOROTHY Mass Foot Measurement Campaign Aleš JURCA, Tomaž KOLŠEK, Tina VIDIC UCS d.o.o., Vrhnika, Slovenia	338	#31
Technical Session 13: Processing of Scan Data	pag.	paper#
Geometrical Processing of 3D Body Scanner Data for Anthropometric Applications Christian LOVATO ^a , Umberto CASTELLANI ^b , Carlo ZANCANARO ^a and Andrea GIACHETTI ^b ^a Dept. of Neurological, Neuropsychological, Morphological and Movement Sciences, University of Verona, b Department of Informatics, University of Verona, Italy	345 a, Italy;	#08
3D Modeling and Size Adaptation of Individual Human Body Avatars from Parametric Measurement Data for 3D Construction and Analysis Tasks Viktoriya KLEBAN, Lothar PAUL GFal, Gesellschaft zur Förderung angewandter Informatik e.V. Berlin (GFal), Germany	353	#04
Touchless Detailed 3D Scan of Human Hand Anatomy Using Time-of-Flight Cameras Jochen PENNE, Martin PROFITTLICH, Thorsten RINGBECK, Bernd BUXBAUM PMDTechnologies GmbH, Siegen, Germany	361	#25
An Examination of the Differences in the Angles Created in the Lower and Upper Extremities During Tennis Serves by Male and Female Players Ayhan GOKTEPE ^a , Hakan KARABORK ^b , Engin KOCAMAN ^a ^a Technical Science College, Selcuk University, Konya, Turkey; ^b Engineering and Architecture Faculty, Selcuk University, Konya, Turkey	369	#17
Technical Session 14: Body Scanning for Apparel III	pag.	paper#
Commercialising Size Survey Data SizeUK - The UK National Size Survey Andrew CRAWFORD ^a and Alexandre KUNG ^b ^a Sizemic Ltd., London, UK; ^b INSTITUT TPC, Hong Kong, China	375	#37
Everything in 3D: Developing the Fashion Digital Studio Philip DELAMORE, David SWEENEY London College of Fashion, University of the Arts London, UK	383	#36
Apparel-Oriented Anthropometric Database of Colombian Military Personnel David MONTANO, Ana María POLANCO, Alejandro MARANON Department of Mechanical Engineering, Universidad de Los Andes, Bogota, Colombia	395	#50
Anthropometrical Measurements for Three-Dimensional Clothing Design Inga DABOLIŅA, Ausma VIĻUMSONE, Janis DABOLIŅŠ Institute of Textile Materials Technology and Design, Riga Technical University, Latvia	404	#57
Author index	411	