CLAWAR 2013

16th International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines,

University of Technology, Sydney, Australia,

14-17 July 2013

(http:// clawar2013.feit.uts.edu.au)

CLAWAR 2013 Programme Summary

Sunday 14 July 2013		
13.00-18.00	Registration open	(ACC)
18.00-20.00	Welcome Reception	(ACC)

Monday 15 July 2013			
Time	Programme session		
09.00-09.20	Opening		(ACC)
09.20-10.20	Keynote-1: Homayoon Kazerooni		(HJBR)
10.20-10.40	**Coffee**		(Lobby)
10.40-12.40	Session A1 (Harris)	Session B1 (Jones)	Session C1 (Broadway)
10.40-11.00	73	74	43
11.00-11.20	25	24	9
11.20-11.40	30	90	59
11.40-12.00	53	52	105
12.00-12.20	19	69	51
12.20-12.40	100	42	
12.40-14.00	**Lunch**		(AFC)
14.00-15.20	Plenary lectures (G)		(HJBR)
14.00-14.20	10 - Qilong Yuan and I-Ming Chen		
14.20-14.40	89 - Gurvinder S Virk, Carol Herman, Roger Bostelman and Tamas Haidegger		
14.40-15.00	115 - Ki-Yeop Sung and Seungbin Moon		
15.00-15.20	05 - M. Osman Tokhi		
15.20-15.40	**Tea**		(Lobby)
15.40-17.40	Session D1 (Harris)	Session E1 (Jones)	Session F1 (Broadway)
15.40-16.00	63	81	47
16.00-16.20	112	37	46
16.20-16.40	66	32	39
16.40-17.00	56	57	15
17.00-17.20	86	93	54
17.20-17.40	41		
17.40-18.20	CA AGM		(HJBR)

Tuesday16 July 2013			
Time	Programme session		
09.20-10.20	Keynote-2: Yvan Baudoin		(HJBR)
10.20-10.40	**Coffee**		(Lobby)
10.40-12.40	Session A2 (Harris)	Session B2 (Jones)	Session C2 (Broadway)
10.40-11.00	6	33	26
11.00-11.20	95	20	34
11.20-11.40	98	21	45
11.40-12.00	29	75	97
12.00-12.20	106	91	22
12.20-12.40	72	92	
12.40-14.00	**Lunch**		(AFC)
14.00-15.00	Keynote-3: Marcus Pandy		(HJBR)
15.00-15.20	CA Report & CLAWAR2014/15		(HJBR)
15.20-15.40	**Tea**		Lobby)
15.40-18.00	Session D2 (Harris)	Session E2 (Jones)	Session F2 (Broadway)
15.40-16.00	49	104	7
16.00-16.20	35	76	67
16.20-16.40	40	14	107
16.40-17.00	64	60	108
17.00-17.20	77	8	88
17.20-17.40	55	11	28
17.40-18.00			23
19.30 - 22.00	**Banquet**		(M-III)

Key:
ACC: Aerial Conference Centre lobby
AFC: Aerial function Centre
M-III: Matilda III, Pier 26, Cockle Bay
HJBR: Harris, Jones, Broadway Rooms

Wednesday 17 July 2013			
Time	Programme session		
09.20-10.20	Keynote-4: Yohihiko Nakamura		(HJBR)
10.20-10.40	**Coffee**		(Lobby)
10.40-12.40	Session A3 (Harris)	Session B3 (Jones)	Session C3 (Broadway)
10.40-11.00	27	102	87
11.00-11.20	78	65	13
11.20-11.40	12	99	48
11.40-12.00	94	16	17
12.00-12.20	31	68	18
12.20-12.40	38	79	96
12.40-14.00	**Lunch**		(AFC)
14.00-15.00	Session D3 (Harris)	Session E3 (Jones)	Session F3 (Broadway)
14.00-14.20	84	70	82
14.20-14.40	44	36	58
14,40-15.00	113	61	110
15.00-15.20	**Tea**		(Lobby)
15.20-15.40	**Closure**		(HJBR)
15.40-	**Laboratory Tour** Centre for Autonomous Systems, University of Technology, Sydney Australian Centre for Field Robotics, University of Sydney		

Note:
Numbers in the presentation slots are ID#s of papers

CLAWAR 2013 Organizing Committees

General Chair:	Kenneth J Waldron, University of Technology Sydney (Australia) and Stanford University (USA)
Program Chair:	M. Osman Tokhi, University of Sheffield, UK
International Advisory Committeee Chair:	Gurvinder S. Virk , University of Gavle, Sweden
Local Organising Committee Chair:	Dikai Liu, University of Technology Sydney, Australia

International Advisory Committee:

H. Levent Akin, Turkey	Bryan Bridge, UK	Ming Xie, Singapore
Manuel Armada, Spain	Noah J. Cowan, USA	H. Levent Akin, Turkey
Abul K M Azad, USA	Hideo Fujimoto, Japan	Manuel Armada, Spain
Karsten Berns, Germany	Krzysztof Kozlowski, Poland	Abul K M Azad, USA
Philippe Bidaud, France	Giovanni Muscato, Italy	

Local Organizing Committee:

Dikai Liu, University of Technology, Sydney	Gavin Paul, University of Technology, Sydney
Gabriel Aguirre-Ollinger, University of Technology, Sydney	Phillip D Quin, University of Technology, Sydney
Gamini Dissanayake, University of Technology, Sydney	Surya P. N. Singh, University of Queensland
Ian Manchester, University of Sydney	

International Program Committee

Muhammad Abdallah, USA
Majid N. Ahmadabadi, Iran
Md Shafiul Alam, Bangladesh
Fareg M Aldbrez, UK
Ronald Arkin, USA
John S Baras, USA
Faiz Benamar, France
Bishakh Bhattacharya, India
John Billingsley, Australia
Fabio Bonsignorio, Italy
Roger V. Bostelman, USA
Kaddour Bouazza-Marouf, UK
Stephen Cameron, UK
Hong Cheng, China
Xuedong Cheng, China
Christine Chevallerau, France
Daisuke Chugo, Japan
Holk Cruse, Germany
Abbas Dehghani, UK
Pablo G de Santos, Spain
Rüdiger Dillmann, Germany
Tony J. Dodd
Sanja Dogramadzi, UK
Steven Dubowsky, USA
Max Suell Dutra, Brazil
Ashish Dutta, India
Luigi Fortuna, Italy
Yili Fu, China
Elena Garcia, Spain
Yiannis Gatsoulis, UK
Khaled M. Goher, Oman
Ambarish Goswami, USA
Valery Gradetsky, Russia
Roderich Gross, UK
Yisheng Guan, China
Satyandra K. Gupta, USA
Aarne Halme, Finland
Neil Heyes, UK
Alamgir Hossain, UK
David Howard, UK
Ion Ion, Romania
Rozita Jailani, Malaysia
Ray Jarvis, Australia
Endre E. Kadar, UK
Petko Kiriazov, Bulgaria
Vijay Kumar, USA
Dirk Lefeber, Belgium
M. Anthony Lewis, USA
Chen Li, USA
Juan Lopez-Coronado, Spain
Hongxu Ma, China
Jose T. Machado, Portugal
Lino Marques, Portugal
Rasha Massoud, Syria
Hiromi Mochiyama
Zaharuddin Mohamed, Malaysia
Seungbin Moon, Korea
Taro Nakamura, Japan
Denny Oetomo, Australia
Dilip Kumar Pratihar, India
Jinwu Qian, China
Michael Rachkov, Russia
Mario Ribeiro, Portugal
Hernando Rodriguez, Columbia
Vitor Santos, Portugal
Tariq P. Sattar, UK
Klaus Schilling, Germany
James Schmiedeler, USA
Hasan Shaheed, UK
H. M Amin Shamsudin, Malaysia
Sanjay K. Sharma, UK
Nazmul H. Siddique
Filipe Silva, Portugal
Mirosław Skibniewski, USA
Leif Steinicke, Belgium
Yuegang Tan, China
László Vajta, Hungary
Anton Vitko, Slovakia
Ping Wang, China
Keigo Watanabe, Japan
Shane Xie, New Zealand
Rong Xiong, China
Ahmet Yigit, Kuwait
Zhaowei W Zhong, Singapore
Changjiu J Zhou, Singapore
Teresa Zielinska, Poland

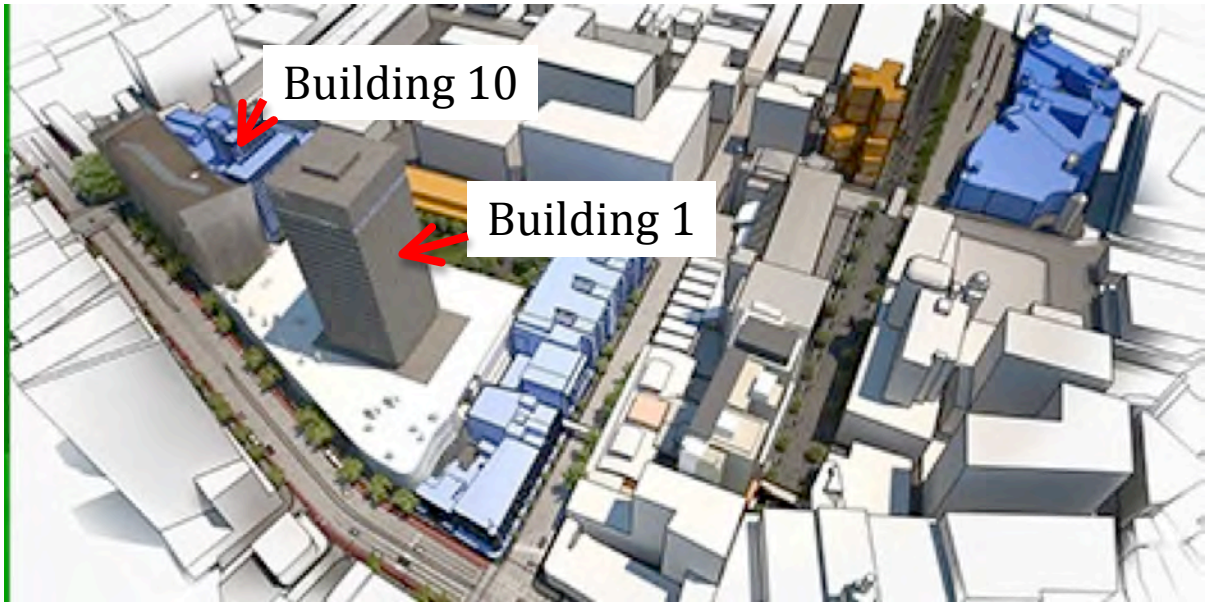
Welcome to Sydney! The University of Technology, Sydney (UTS) is located on an urban campus close to the downtown business district. As such it is easily accessible from any direction. The campus is close to Central Railway Station. It is bounded on the south side by Broadway, which is the major traffic artery from the center of the city that runs to the west. It is intersected by Harris Street that is a major road running south from the Pyrmont district that adjoins the harbor, toward the airport. Located on Broadway near Harris Street is a tall square tower, dark grey in color, with UTS in large letters on top. That is Building 1. It is visible from most any direction in the vicinity of campus, and serves as a useful landmark.

The campus can be reached by a 20 minute taxi ride from the airport. Alternatively, you can take the train. There is a station in the north end of the airport terminal. A ticket to Central costs around $15. Go four stops to Central Station. If you have luggage note that there is an elevator at the extreme north end of the platform. Take the elevator down to the concourse and follow the signs to the Western Forecourt. Cross the large open area and exit toward Railway Square/George Street. As you leave the station look to the left. You should be able to see UTS Building 1.

The campus can be reached from the business district by means of any bus that runs up George Street past Railway Square. However, it is necessary to purchase prepaid bus tickets to use George Street buses. You can get a ticket from any newsagent. There are many hotels within walking distance of campus. The closest are the Mercure Sydney, which is on the UTS end of Railway Square, the Citigate Central Sydney, which is on Thomas St. adjacent to campus, and the Adina Executive, Central Sydney, which is on Railway Square closer to the station. The Darling Harbour hotels are accessible either by walking down Harris Street, or by walking down Quay Street past the Market City Building, depending whether they are on the left side, or the right side of the bay, respectively.

CLAWAR 2013 will be held in the Aerial Function Center, which is located on the top floor of one wing of UTS Building 10. To locate Building 10 go along Broadway in the direction away from downtown. You will pass Building 2 that simply appears to be a shoulder of Building 1. You will come to Jones Street, now closed off from vehicle access to Broadway. Turn right into Jones Street. You will notice construction sites on both sides of the street. Beyond the construction site on the left is Building 10. It has an antenna mast on the roof.

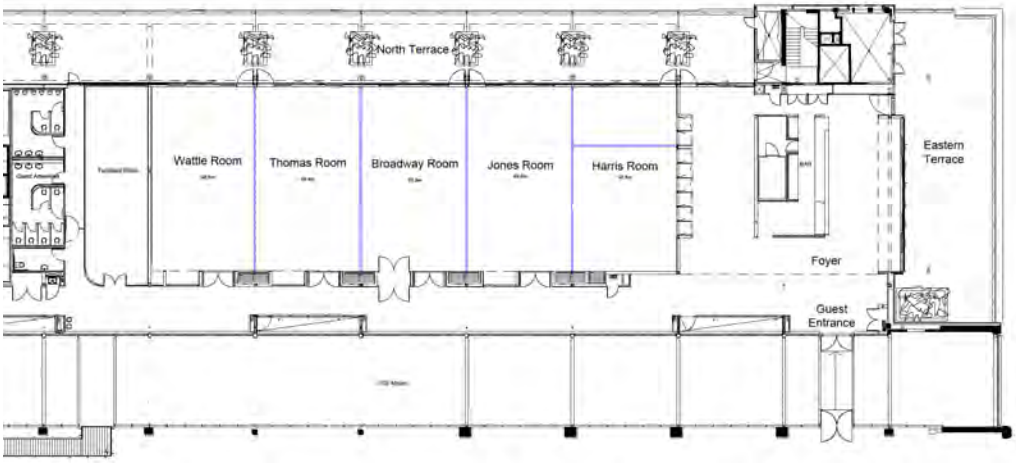
Take any elevator up to Level 7. Turn left after you leave the elevator and cross the bridge over the atrium. You are now in the Aerial Function Centre.



We will be using the three meeting rooms nearest the front: the Harris, Jones and Broadway rooms (see below). We will also be using the Foyer. Coffee will be set up in the passage that provides access to the meeting rooms.

FUNCTION ROOM PLAN

Aerial UTS Function Centre



Keynote Addresses

Exoskeleton Systems for Medical and Civilian Applications

H. Kazerooni
Professor, University of California at Berkeley

Abstract

For widespread use, exoskeletons must be accessible. The medical wearable robotic exoskeletons allow people with paraplegia or other mobility disorders to be upright and mobile, preventing secondary diseases and enhancing their quality of life. These systems will be used for in-home care and everyday use, as well as within hospitals and rehabilitation centers. The industrial wearable robotic systems minimize spinal compression forces of workers who repeat various maneuvers on the job. These devices will be used in auto assembly plants, factories, manufacturing facilities, distribution centers, warehouses, and delivery services. These systems decrease the severity and number of work-related injuries, while enhancing worker safety. The quest to develop accessible exoskeleton orthotic systems suggests less hardware while placing more emphasis on the intelligence and cleverness during both the design stage and the device operation. This talk will describe new engineering developments to realize accessible exoskeleton systems.

Biography

Dr. Kazerooni is a Professor in the Mechanical Engineering Department at the University of California, Berkeley and director of the Berkeley Robotics and Human Engineering Laboratory. The laboratory's mission is to develop fundamental scientific and engineering principles on robotics, control sciences, exoskeletons, and bioengineering. Dr. Kazerooni is also the founder of Ekso Bionics. Most of the developed technologies in this lab have found their ways to market. Prior to his research work on lower extremity exoskeletons, Dr. Kazerooni led his team to successfully develop robotics systems that enhance human upper extremity strength. The results of this work led to a new class of intelligent assist devices currently being used by workers worldwide for manipulating heavy objects in distribution centers and factories. Dr. Kazerooni holds a Doctorate in Mechanical Engineering from MIT and has published more than two hundred articles, delivered over 100 plenary lectures in the U.S. and internationally, and holds numerous pertinent patents and awards. As a noted authority on robotics, he is frequently profiled and quoted in the media.

TIRAMISU : FP7-Project for an integrated toolbox in Humanitarian Demining, focus on UGV, UAV, technical survey and close-in-detection

Yvan Baudoin
Royal Military Academy (RMA), Brussels, Belgium

Abstract

The TIRAMISU project aims at providing the foundation for a global toolbox that will cover the main mine action activities, from the survey of large areas to the actual disposal of explosive hazards, including mine risk education and training tools. After a short description of some tools, particular emphasis will be given to the possible use of UAV (or UGV/UAV) in Technical survey and/or Close-in-Detection.

Biography
Title: Professor emeritus
Position: Executive Head of the Unmanned Vehicle Centre, Scientific collaborator of the Polytechnic faculty, Former Head of the Department of Mechanical Engineering
Organization: Polytechnic Faculty, Royal Military Academy (RMA), Brussels, Belgium
Educational Background:

- Engineer Electro-Mechanical Engineering (Polytechnics, Brussel)
- Post-Master Automatic/Robotics Engineering (Free University, Brussels)
- Post-Master High Statistical Studies (University Paris VI)
- Doctor Honoris Causa (Technical University of Iasi, Romania)

Areas of Interests & Contribution in the IT Field:

- Head of Programming Division of Informatics Centre of Belgian Defense (79/83)
- Member of NATO: Working Groups on Robotics, Human-Machine-Interfaces, Advanced Electrical Mobility Control (85/2011)
- Voting Member NATO/Research and Technical Organisation/Applied vehicle Technology (2008-2011)
- EDA (European Defense Agency) Project-Initiator in Multi-Robotics Cooperation (2005-2009) (NMRS)
- Head of IARP (International Advanced Robotics Program) Working Group on Robotics for Humanitarian De-mining (HUDEM), Robotics for Risky Interventions (RISE) and official Belgian Representative in IARP (2001- 2011)
- FP6 – View-Finder Robotics Project (2006/2009)
- Former Deputy Director of CLAWAR (Robotics) Association (2006- 2010)
- EUREKA project TENEEST (2007- 2011)
- FP7 – TIRAMISU Coordinator (2012-2015)
- FP7 – ICARUS Member of Project management Team (2012-2015)

Muscle Coordination of Human Locomotion

Marcus Pandy
Department of Mechanical Engineering, University of Melbourne

Abstract

Gait-analysis techniques have been used for more than a century to provide information on the kinematics and kinetics of human locomotion, yet the ability of this technique to quantify function is limited because it cannot be used to discern the actions of individual muscles. Computational modelling is the only means available to determine musculoskeletal loading non-invasively. Rapid increases in computing power combined with recent advances in imaging and more efficient algorithms for modelling the musculoskeletal system have enabled more detailed analyses of lower-limb muscle function. This presentation will illustrate how computational modelling has been used to study muscle coordination of human locomotion across a wide spectrum of walking and running speeds. The results have important applications in medicine (orthopaedics), sports (training and injury prevention) and robotics.

Biography

Marcus Pandy is appointed as Chair of Mechanical and Biomedical Engineering in the Department of Mechanical Engineering at The University of Melbourne. He received a PhD in mechanical engineering from the Ohio State University, Columbus. Prior to joining the University of Melbourne, he held the Joe J. King Professorship in Biomedical Engineering at the University of Texas at Austin. He is a Fellow of the American Institute of Medical and Biological Engineering, the

American Society of Mechanical Engineers and the Institute of Engineers Australia. A focus of Pandy's research is to combine biomechanical experiments and computational modelling to describe and explain muscle and joint function during daily activities such as gait.

Symbol-Based Communication between Humans and Humanoids

Yoshihiko Nakamura
University of Tokyo

Abstract:

Evolution of the human brain emerged by the pressure for communication. It is hard to believe that the pressure of evolution exempted the features of motion patterns from using them for communication. The communication skill is therefore anthropomorphic.

The author would like to call the natural function of the brain to perceive, recognize, understand and respond to the human-like motion patterns, the Anthropomorphic Biological Equipment. The natural and general human-machine interface can be established by developing the similar function on the machine side, which we may call the Anthropomorphic Artificial Equipment. Our research started from the mathematical model of mirror neurons and continues to acquisition of semiology of human behaviors based on technologies such as unsupervised segmentation, iterative clustering, and construction of state transition network. The current research interests target to connect the behavioral semiology to the semiology of a natural language to develop a statistical system that evokes mutual association. This talk introduces the scope of our research and overviews the direction of research.

Biography:

Yoshihiko Nakamura received Doctor of Engineering Degree from Kyoto University in 1985. He was Assistant Professor of Kyoto University, from 1982 to 1987, and then Assistant and Associate Professor of University of California, Santa Barbara from 1987 to 1991. Since 1991, he has been with University of Tokyo, Japan, and is currently Professor at Department of Mechano-Informatics. Humanoid robotics, cognitive robotics, neuro musculoskeletal human modeling, biomedical systems, and their computational algorithms are his current fields of research. He is Fellow of Japan Society of Mechanical Engineers, Fellow of Robotics Society of Japan, Fellow of IEEE, and Fellow of World Academy of Arts and Science. Dr. Nakamura currently (2012-2015) serves as President of International Federation for the Promotion of Mechanism and Machine Science (IFToMM). Dr. Nakamura is Foreign Member of Academy of Engineering Science of Serbia, and TUM Distinguished Affiliated Professor of Technische Universität München.

Invited Lecture

Human Motion Capture, Localization and Interaction Based on Wearable Inertial and Contact Sensors

Qilong Yuan and I-Ming Chen

Abstract

The human body kinematics and kinetics with the environment are the crucial features to correctly represent the human- environment interaction. This paper introduces the framework of the system and method to track the spatial human motion interaction with the environment. In this work, the wearable sensors systems are used to measure the kinematic parameters of the body segment and the contact with the environment. Though monitoring the contacts, and capturing the body joint movement, the

spatial location of the person can be updated during contacts. Methods on tracking the spatial location, velocity of a person are also discussed. In general, the system and method is able to fully track the spatial behavior, location and velocity of the person during various motions without volume and terrain limitations. The self-contained solution has litter restriction on the subject's movement. It can be applied to many daily activity related applications such as sports and exercises, personal navigation and entertainment etc.

Biography

Prof. I-Ming Chen, *Fellow* of IEEE, *Fellow* of ASME, and *General Chairman* of IEEE International Conference on Robotics and Automation (ICRA) 2017, Singapore, is a world renowned roboticist with significant contributions in modular robotics, actuation design and wearable mechatronics. For the past 10 years, he had received funding of more than S$10 million in the related areas as Principal investigator. He is currently Director of Intelligent Systems Centre, which is co-funded by NTU and ST Engineering and also Director of Robotics Research Center of NTU. He received the B. S. degree from National Taiwan University in 1986, and M. S. and Ph. D. degrees from California Institute of Technology, Pasadena, CA in 1989 and 1994 respectively. His research interests are in wearable sensors, human-robot interaction, reconfigurable automation, parallel kinematics machines (PKM), biomorphic underwater robots, and smart material based actuators. Prof. Chen has published more than 270 papers in refereed international journals and conferences as well as book chapters. He has been serving on the editorial boards of IEEE Transactions on Robotics, IEEE/ASME Transactions on Mechatronics, Mechanism and Machine Theory, and Robotica.

CLAWAR 2013 Program

Sunday, July 14th

13.00 – 18.00	Registration open	Venue: Aerial Conference Centre Lobby
18.00 – 20.00	Welcome Reception Aerial Conference Centre, 7th Floor, Building 10 235 Jones St., Broadway, Sydney 2007, University of Technology, Sydney	

Monday, July 15th

09.00 – 09.20	Conference Opening Session Aerial Conference Centre, 7th Floor, Building 10 235 Jones St., Broadway, Sydney 2007

Keynote Address – 1 Session Chair: Gurvinder S. Virk			
Date: Monday 15 July 2013			Venue: Harris, Jones, Broadway Rooms
Time	Paper ID	Proc. Page	Presentation
09.20 – 10.20	4	8	Exoskeleton systems for medical and civilian applications *Homayoon Kazerooni*

10.20 – 10.40	**Coffee Break**	Venue: Lobby

Session – A1: Multi-legged Robots Session Chair: Manuel Armanda			
Date: Monday 15 July 2013		Time: 10.40 – 12.40	Venue: Harris Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	73	511	A1.1 - Actuator sizing for highly dynamic quadruped robots based on squat jumps and running trots *Hamza Khan, Claudio Semini and Darwin Caldwell*
11.00 – 11.20	25	215	A1.2 - Adaptive control of leg position for hexapod robot based on somatosensory feedback and organic computing principles *Ahmad Al-Homsy, Jan Hartmann and Erik Maehle*
11.20 – 11.40	30	761	A1.3 - Biped walking over rough terrain by adaptive ground reference map *Ning Wu, Chee-Meng Chew and Aun Neow Poo*

11.40 – 12.00	53	471	A1.4 - Design and prototyping of active-suspension-based 4-legged running robot with anteroposterior asymmetry in body *Kyoko Nishimura, Kazuyoshi Tsutsumi, Shinji Sakio and Koji Shibuya*
12.00 – 12.20	19	435	A1.5 - Development of hexapod robot supported mechanically using pneumatic rubber artificial muscles *Hiroki Tomori, Yusuke Hirata, Taro Nakamura and Hisashi Osumi*
12.20 – 12.40	100	709	A1.6 - Development of a quadruped robot model in simmechanics *Manuel Silva, Ramiro Barbosa and Tomás Castro*

Session – B1: Human Assist Devices Session Chair: Abbas Dehghani			
Date: Monday 15 July 2013		Time: 10.40 – 12.40	Venue: Jones Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	74	93	B1.1 - Variable impedance control of a parallel robot for ankle rehabilitation *Sheng Quan Xie and Yun Ho Tsoi*
11.00 – 11.20	24	35	B1.2 - Development of a lower extremity exoskeleton system for walking assistance while load carrying *Wan soo Kim, Hee don Lee, Dong hwan Lim, Jung soo Han and Chang soo Han*
11.20 – 11.40	90	109	B1.3 - A simple load estimation of a patient during a standing assistance motion *Takahiro Yamada, Daisuke Chugo, Shoyo Yokota and Hiroshi Hashimoto*
11.40 – 12.00	52	59	B1.4 - Actuator with adjustable-rigidity and embedded sensor for an active orthosis knee joint *Manuel Cestari, Daniel Sanz-Merodio, Juan Carlos Arevalo, Xavier Carrillo and Elena Garcia*
12.00 – 12.20	69	153	B1.5 - A comparison of a passive and variable-damping controlled leg prosthesis in a simulated environment *Jie Zhao, Karsten Berns, Roberto Baptista and Antonio Bo*
12.20 – 12.40	42	43	B1.6 - Dynamic coupling characteristics of a semi-active knee prosthesis *Mohammed Awad, Abbass Dehgahni, David Moser and Saeed Zahedi*

Session – C1: Climbing Robots Session Chair: John Billingsley			
Date: Monday 15 July 2013		Time: 10.40 – 12.20	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation

10.40 – 11.00	43	343	C1.1 - Climbing robot equipped with a postural adjustment mechanism for conical poles *Yasuhiko Ishigure, Haruhisa Kawasaki, Taichi Kato, Katuyuki Hirai, Nobuyuki Iinuma and Satoshi Ueki*
11.00 – 11.20	9	309	C1.2 - Examination of surface feature analysis and terrain traversability for a wall-climbing robot *Daniel Schmidt, Marcel Jung and Karsten Berns*
11.20 – 11.40	59	701	C1.3 - Finite element modelling of the adhesion system of a vortex based climbing robot *Filippo Bonaccorso, Salvatore D'Urso, Domenico Longo and Giovanni Muscato*
11.40 – 12.00	105	375	C1.4 - Optimal design of a magnetic adhesion system for climbing robots *Peter Ward, Dikai Liu, Ken Waldron and Mahdi Hassan*
12.00 – 12.20	51	578	C1.5 - Studies of total adhesive force of multiple magnetic wheels for a climbing robot *Arsit Boonyaprapasorn, Kaned Thung-Od, Rardchawadee Silapunt and Thavida Maneewarn*

12.40 – 14.00	**Lunch Break**	Venue: Aerial Function Centre

Session – G1: Plenary Lectures
Session Chair: Gurvinder S. Virk

Date: Monday 15 July 2013	Time: 14.00 – 15.20	Venue: Harris, Jones, Broadway Rooms

Time	Paper ID	Proc. Page	Presentation
14.00 – 14.20	10	807	G1.1 - Human motion capture, localization and interaction based on wearable inertial and contact sensors *Qilong Yuan and I-Ming Chen*
14.20 – 14.40	89	833	G1.2 - Challenges of the changing robot markets *Gurvinder Singh Virk, Carol Herman, Roger Bostelman and Tamas Haidegger*
14.40 – 15.00	115	841	E3.4 - OFEX 2.0: Database for performance evaluation of object feature extraction algorithms *Ki-Yeop Sung and Seungbin Moon*
15.00 – 15.20	05	849	G1.3 - Ethical assessment of robots *M. Osman Tokhi*

15.20 – 15.40	**Tea Break**	Venue: Lobby

Session – D1: Locomotion Control Session Chair: Dikai Liu			
Date: Monday 15 July 2013		Time: 15.40 – 17.40	Venue: Harris Room
Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	63	495	D1.1 - A behavior-based library for locomotion control of kinematically complex robots *Malte Langosz, Lorenz Quack, Alexander Dettmann, Sebastian Bartsch and Frank Kirchner*
16.00 – 16.20	112	667	D1.2 - A novel hybrid spiral-dynamics random-chemotaxis optimization algorithm with application to modelling of a flexible robot manipulator *Ahmad Nor Kasruddin Nasir and M. Osman Tokhi*
16.20 – 16.40	66	281	D1.3 - A simplified variable admittance controller based on a virtual agonist-antagonist mechanism for robot joint control *Xiaofeng Xiong, Florentin Wörgötter and Poramate Manoonpong*
16.40 – 17.00	56	189	D1.4 - BFA optimisation of control parameters of a new structure two wheeled robot on inclined surface *Saad Agouri, M. Osman Tokhi, Abdulla Almeshal and Khaled Goher*
17.00 – 17.20	86	651	D1.5 - Force sensing and control during movement and object manipulation in MERO walking robots *Ion Ion, Curaj Adrian, Vasile Aurelian, Dumitru Iulia and Stamatescu Grigore*
17.20 – 17.40	41	729	D1.6 - Velocity control of serial elastic actuator based on EKF estimator and neural network *Yichao Mao, Rong Xiong, Qiuguo Zhu and Jian Chu*

Session – E1: Bipedal Robots Session Chair: Surya P. N. Singh			
Date: Monday 15 July 2013		Time: 15.40 – 17.20	Venue: Jones Room
Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	81	529	E1.1 - A hip joint structure for biped robot with reduced DOF's of motion *Satoshi Ito, Akihiro Nakazawa, Takeshi Onozawa, Shingo Nishio and Minoru Sasaki*
16.00 – 16.20	37	463	E1.2 - An actuated continuous spring loaded inverted pendulum (slip) model for the analysis of bouncing gaits *Daniel Jacobs, Linus Park and Kenneth Waldron*
16.20 – 16.40	32	383	E1.3 - Compliance foot system design for bipedal robot walking over uneven terrain *Ning Wu, Boon-Hwa Tan and Chee-Meng Chew*

16.40 – 17.00	57	822	E1.4 - Estimation of the trunk attitude of a humanoid by data fusion of inertial sensors and joint encoders *Siddhartha Khandelwal and Christine Chevallereau*
17.00 – 17.20	93	537	E1.5 - Exploring the Lombard paradoxon in a bipedal musculoskeletal robot *Katayon Radkhah and Oskar von Stryk*

Session – F1: Actuation Session Chair: Abul Azad			
Date: Monday 15 July 2013		Time: 15.40 – 17.20	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	47	257	F1.1 - A resilient robotic actuator based on an integrated sensorized elastomer coupling *Jan Paskarbeit, Salvatore Annunziata and Axel Schneider*
16.00 – 16.20	46	249	F1.2 - Bio-inspired elbow impedance modulation using a compliant technical joint drive *Salvatore Annunziata, Jan Paskarbeit and Axel Schneider*
16.20 – 16.40	39	693	F1.3 - Design of SMA based actuators used in robotics *Muhammet Ozturk and Basaran Bahadir Kocer*
16.40 – 17.00	15	327	F1.4 - Development of worm-rack driven cylindrical crawler unit *Jun-ya Nagase, Koichi Suzumori and Norihiko Saga*
17.00 – 17.20	54	273	F1.5 - Improvement of energy consumption by movement of center of rotation of joint *Kazutoshi Tanaka, Satoshi Nishikawa and Yasuo Kuniyoshi*

17.20 – 18.20	**CLAWAR Association Annual General Meeting**	Venue: Harris, Jones, Broadway Rooms

Tuesday, July 16th

Keynote Address – 2 Session Chair: Giovanni Muscato			
Date: Tuesday 16 July 2013			Venue: Harris, Jones, Broadway Rooms
Time	Paper ID	Proc. Page	Presentation
09.20 – 10.20	1	3	TIRAMISU : FP7-Project for an integrated toolbox in Humanitarian Demining, focus on UGV, UAV, technical survey and close-in-detection *Yvan Baudoin*

10.20 – 10.40	**Coffee Break**	Venue: Lobby

Session – A2: Multi-legged Robots Session Chair: Piotr Skrzypczynski				
Date: Tuesday 16 July 2013		Time: 10.40 – 12.40		Venue: Harris Room
Time	Paper ID	Proc. Page	Presentation	
10.40 – 11.00	6	163	A2.1 - DODEKAPOD as universal intelligent structure for adaptive parallel spatial self-moving modular robots *Sergey Sayapin, Anatoly Karpenko and Hiep Dang Xuan*	
11.00 – 11.20	95	789	A2.2 - Efficiently using RGB-D data to self-localize a small walking robot in man-made environments *Piotr Skrzypczynski*	
11.20 – 11.40	98	555	A2.3 - Inverse dynamics for a quadruped robot locomoting along slippery surfaces *Samuel Zapolsky, Evan Drumwright, Ioannis Havoutis, Jonas Buchli and Claudio Semini*	
11.40 – 12.00	29	451	A2.4 - Event driven ground-impedance identification for legged robots *Juan Carlos Arevalo, Manuel Cestari, Daniel Sanz-Merodio and Elena Garcia*	
12.00 – 12.20	106	399	A2.5 - HEX-PIDERIX: A six-legged walking climbing robot to perform inspection tasks on vertical surfaces *Xochitl Yamile Sandoval-Castro, Mario A. Garcia-Murillo, Jonny Paul Zabala-DePaz and Eduardo Castillo-Castaneda*	
12.20 – 12.40	72	503	A2.6 - Effects of neck swing motion on the body posture of a four-legged robot *Koji Shibuya and Kenji Matsuhira*	

Session – B2: Human Assist Devices Session Chair: Abbas Dehghani			
Date: Tuesday 16 July 2013		Time: 10.40 – 12.40	Venue: Jones Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	33	223	B2.1 - Implementation of an adjustable compliant knee joint in a lower-limb exoskeleton *Daniel Sanz-Merodio, Manuel Cestari, Juan Carlos Arevalo and Elena Garcia*
11.00 – 11.20	20	19	B2.2 - The designing of the exoskeleton leg with pneumatic drives *Artyom Sukhanov, Valery Gradetsky, Maxim Knyazkov, Eugeniy Semyonov and Ivan Ermolov*
11.20 – 11.40	21	27	B2.3 - Motion control algorithms for the exoskeleton equipped with pneumatic drives *Anastasiya Kryukova, Valery Gradetsky, Maxim Knyazkov, Evgeny Semyonov, Ivan Ermolov and Artyom Sukhanov*
11.40 – 12.00	75	68	B2.4 - A personal robot integrating a physically-based human motion tracking and analysis *Consuelo Granata, Philippe Bidaud, Ragou Ady and Joseph Salini*
12.00 – 12.20	91	232	B2.5 - New propulsion system with pneumatic artificial muscles *Ivanka Veneva*
12.20 – 12.40	92	117	B2.6 - Exoskeletons for assisting human walking *Gurvinder Singh Virk and Indrawibawa Nyoman*

Session – C2: Field Robots Session Chair: Gabriel.Aguirre-Ollinger			
Date: Monday 16 July 2013		Time: 10.40 – 12.20	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	26	85	C2.1 - Transition analysis of a biped pole-climbing robot -- CLIMBOT *Haifei Zhu, Yisheng Guan, Wenqiang Wu, Xuefeng Zhou and Hong Zhang*
11.00 – 11.20	34	241	C2.2 - Development of a wall climbing robot using the mobile mechanism of traveling waves propagation *Yutaka Mizota, Kazutoshi Takahashi, Yusuke Goto and Taro Nakamura*
11.20 – 11.40	45	392	C2.3 - New design of peristaltic crawling robot with an earthworm muscular structure *Hikaru Nozari, Satoshi Tesen, Norihiko Saga, Jun-Ya Nagase and Hiroki Dobashi*

11.40 – 12.00	97	547	C2.4 - An automated system for systematic testing of locomotion on heterogeneous granular media *Feifei Qian, Kevin Daffon, Tingnan Zhang and Daniel Goldman*
12.00 – 12.20	22	171	C2.5 - Aquatic multi-robot system for lake cleaning *Pranay Agrawal and Bishakh Bhattacharya*

12.40 – 14.00	**Lunch Break**	Venue: Aerial Function Centre

Keynote Address – 3 Session Chair: Manuel Armanda			
Date: Tuesday 16 July 2013			Venue: Harris, Jones, Broadway Rooms
Time	Paper ID	Proc. Page	Presentation
14.00 – 15.00	3	7	Muscle coordination of human locomotion *Marcus Pandy*

15.00 – 15.20	**CLAWAR Association Report, CLAWAR 2014 &2015**	Venue: Harris, Jones, Broadway Rooms

15.20 – 15.40	**Tea Break**	Venue: Lobby

Session – D2: Locomotion Control Session Chair: Seungbin Moon			
Date: Tuesday 16 July 2013		Time: 15.40 – 17.40	Venue: Harris Room
Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	49	740	D2.1 - Low-dimensional user control of autonomously planned whole-body humanoid locomotion motion towards motor-imagery BCI application *Karim Bouyarmane, Joris Vaillant and Jun Morimoto*
16.00 – 16.20	35	719	D2.2 - Model-based elastic tendon control for electrically actuated musculoskeletal bipedal robots *Katayon Radkhah and Oskar von Stryk*
16.20 – 16.40	40	625	D2.3 - Neural control of a three-legged reconfigurable robot with omnidirectional wheels *Poramate Manoonpong, Florentin Wörgötter and Pudit Laksanacharoen*
16.40 – 17.00	64	659	D2.4 - Object grasping with dual flexible manipulator using genetic algorithms *Mohd Abdul Hadi Hassan and M. Osman Tokhi*

17.00 – 17.20	77	519	D2.5 - Previewed impedance adaptation to coordinate upper-limb trajectory tracking and postural balance in disturbed conditions *Aurelien Ibanez, Philippe Bidaud and Vincent Padois*
17.20 – 17.40	55	179	D2.6 Hybrid spiral dynamic bacterial chemotaxis optimisation for hybrid fuzzy logic control of a novel two wheeled robotic vehicle *Abdullah Almeshal, Khaled Goher, M. Osman Tokhi and Ahmad N. K. Nasir*

Session – E2: Bipedal Locomotion
Session Chair: Giovanni Muscato

Date: Tuesday 16 July 2013	Time: 15.40 – 17.40	Venue: Jones Room

Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	104	125	E2.1 - Hopping machine: A tool for human running simulation and for legged robots and exoskeleton design *André H. Maia, Sérgio Laquini Jr, Antônio Bento Filho, Victor Hugo Brito Fernandes and Elena Garcia*
16.00 – 16.20	76	101	E2.2 - A mobile 3d vision-based embedded system for robust estimation and analysis of human locomotion *Cong Zong, Philippe Bidaud and Xavier Clady*
16.20 – 16.40	14	571	E2.3 - Shuffle turn of humanoid robot simulation based on EMG measurement *Masanao Koeda, Takayuki Serizawa and Yuta Matsui*
16.40 – 17.00	60	487	E2.4 - Walking despite the passive compliance: Techniques for using conventional pattern generators to control intrinsically compliant humanoid robots *Przemyslaw Kryczka, Petar Kormushev, Kenji Hashimoto, Hun-ok Lim, Nikolaos Tsagarakis, Darwin Caldwell and Atsuo Takanishi*
17.00 – 17.20	8	411	E2.5 - Reinforcement learning of bipedal lateral behaviour and stability control with ankle-roll activation *Bernhard Hengst*
17.20 – 17.40	11	419	E2.6 - Obstacle/gap detection and terrain classification of walking robots based on a 2D laser range finder *Patrick Kesper, Eduard Grinke, Frank Hesse, Florentin Wörgötter and Poramate Manoonpong*

Session – F2: Configuration Session Chair: Daisuke Chugo			
Date: Tuesday 16 July 2013		Time: 15.40 – 18.00	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation
15.40 – 16.00	7	141	F2.1 - Integrated design, modelling and analysis of two-wheeled wheelchair for disabled *Abqori Aula, Tareq M. Altalmas, Salmiah Ahmad, Rini Akmeliawati, Shahrul Naim Sidek and M. Osman Tokhi*
16.00 – 16.20	67	585	F2.2 - Quantitative kinematic performance comparison of reconfigurable leg-wheeled vehicles *Aliakbar Alamdari, Robin Herin and Venkat Krovi*
16.20 – 16.40	107	749	F2.3 - State to state motion planning for underactuated systems using a modified rapidly exploring random tree algorithm *Rina Shvartsman, Ying Tan and Denny Oetomo*
16.40 – 17.00	108	633	F2.4 - The passive dynamics of walking and brachiating robots: Results on the topology and stability of passive gaits *Nelson Rosa Jr. and K. M. Lynch*
17.00 – 17.20	88	359	F2.5 - Layered body for flexible mono-tread mobile track *Takafumi Haji, Shinichi Araki, Tetsuya Kinugasa, Koji Yoshida, Hisanori Amano, Ryota Hayashi, Kenichi Tokuda and Masatsugu Iribe*
17.20 – 17.40	28	643	F2.6 - Modeling and analysis of robotic grasping using soft fingertips *Akhtar Khurshid, Abdul Ghafoor, M Afzaal Malik and Yasar Ayaz*
17.40 – 18.00	23	677	F2.6 - Modelling of movement of the three-link robot with operated friction forces on the horizontal surface *Sergey Jatsun, Lyudmila Volkova, Grigoriy Naumov and Andrey Yatsun*

19.30 – 22.00 (Boarding 19.15)	**Banquet**	Venue: Matilda III, Pier 26, Cockle Bay

Wednesday, July 17th

Keynote Address – 4 Session Chair: Philippe Bidaud			
Date: Wednesday 17 July 2013			Venue: Harris, Jones, Broadway Rooms
Time	Paper ID	Proc. Page	Presentation
09.20 – 10.20	2	6	Anthropomorphic biological equipment *Yoshihiko Nakamura*

10.20 – 10.40	**Coffee Break**	Venue: Lobby

Session – A3: Walking Robots Session Chair: Piotr Skrzypczynski				
Date: Wednesday 17 July 2013		Time: 10.40 – 12.40		Venue: Harris Room
Time	Paper ID	Proc. Page	Presentation	
10.40 – 11.00	27	443	A3.1 - Local reflex generation for obstacle negotiation in quadrupedal locomotion *Michele Focchi, Victor Barasuol, Ioannis Havoutis, Jonas Buchli, Claudio Semini and Darwin G. Caldwell*	
11.00 – 11.20	78	773	A3.2 - Method for estimating location and yaw angle of a six-legged robot for omni-directional walking control *Hiroaki Uchida, Kouhei Takahashi and Masaya Suzuki*	
11.20 – 11.40	12	427	A3.3 - Motion control for the 6-legged robot in extreme conditions *Yury Golubev, Victor Korianov, Vladimir Pavlovsky and Alexey Panchenko*	
11.40 – 12.00	94	797	A3.4 - Recognition of 3D objects for walking robot equipped with multisense-SL sensor head *Janusz Bedkowski, Karol Majek, Andrzej Masłowski and Piotr Kaczmarek*	
12.00 – 12.20	31	459	A3.5 - The turtle, a legged submerged inspection vehicle *John Billingsley*	
12.20 – 12.40	38	335	A3.6 - Unconventional five-legged robot for agile locomotion *Marek Wasik, Mikolaj Wasielica and Piotr Skrzypczynski*	

Session – B3: Human Interactive Devices Session Chair: Daniel Schmidt			
Date: Wednesday 17 July 2013		Time: 10.40 – 12.40	Venue: Jones Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	102	291	B3.1 - Determination of trajectories using non-invasive BCI techniques in 3D environments *T. Garcia-Egea, C. A. Díaz-Hernández, J. Lopez-Coronado and J. L. Contreras-Vidal*
11.00 – 11.20	65	85	B3.2 - Dynamics of human lower limbs using CGA data and BSIP predictive equations *Antônio Bento Filho, Victor Hugo Brito Fernandes, André Hemerly Maia, Elena Garcia, Anselmo Frizera and Teodiano Bastos*
11.20 – 11.40	99	563	B3.3 - LAURON V: Optimized leg configuration for the design of a bio-inspired walking robot *Arne Roennau, Georg Heppner, Lars Pfotzer and Ruediger Dillmann*
11.40 – 12.00	16	11	B3.4 - Optimization-based gait planning for wearable power-assist locomotor by specifying via-points *Chang Hyun Sung, Takahiro Kagawa, Yoji Uno*
12.00 – 12.20	68	593	B3.5 - Enhancing personal electric vehicles using reconfigurable design *Robin S. Hérin, Aliakbar Alamdari and Venkat N. Krovi*
12.20 – 12.40	79	599	B3.6 - Hand-manoeuvred wheelchair using wheels fitted with feet for enhanced mobility *T. Okada, H. Wada, N. Mimura, T. Shimizu and K. Nagata*

Session – C3: Field Robots Session Chair: Seungbin Moon			
Date: Wednesday 17 July 2013		Time: 10.40 – 12.40	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation
10.40 – 11.00	87	617	C3.1 - Compliance contact control of mecanum wheeled mobile robot for improving safety *Naotaka Nishigami, Naoyuki Takesue, Rikiya Makino, Kouhei Kikuchi, Kousyun Fujiwara and Hideo Fujimoto*
11.00 – 11.20	13	199	C3.2 - Compliant backbone structures in mobile robots *Nicole Kern, Richard Bachmann, Ryan Michols, Ronald Triolo and Roger Quinn*
11.20 – 11.40	48	265	C3.3 - Derivation of mathematical models of the peristaltic crawling robot for maintenance of a mixing tank *Yosuke Morishita, Daisuke Sannohe, Tatsuya Osawa, Tomoya Tanaka and Taro Nakamura*

11.40 – 12.00	17	301	C3.4 - Development of a peristaltic crawling inspection robot with pneumatic artificial muscles for a 25A elbow pipe *Tatsuya Kishi, Taro Nakamura and Megumi Ikeuchi*
12.00 – 12.20	18	207	C3.5 - Development of two types of maintenance robots for a jacket inside a mixing tank *Tomoya Tanaka, Taro Nakamura, Daisuke Sannohe, Yosuke Morisita and Mitsugu Tanaka*
12.20 – 12.40	96	367	C3.6 Surface adaptation robot for defect detection by performing continuously an ultrasound wheel probe *Hernando Leon-Rodriguez*

14.40 – 14.00	**Lunch Break**	Venue: Aerial Function Centre

Session – D3: Sensing and Location
Session Chair: Lars Pfotzer

Date: Wednesday 17 July 2013	Time: 14.00 – 15.00	Venue: Harris Room

Time	Paper ID	Proc. Page	Presentation
14.00 – 14.20	84	781	D3.1 - Cooperative multi-robot localization with radio-based sensors *Lars Pfotzer, Soeren Bohn, Jan Oberlaender, Georg Heppner, Arne Roennau and Ruediger Dillmann*
14.20 – 14.40	44	51	D3.2 - Covered area detection based on brightness change of inner camera images for crawler robot *Kenichi Tokuda, Tatsuya Hirayama, Tetsuya Kinugasa, Takafumi Haji and Hisanori Amano*
14.40 – 15.00	113	317	D3.3 development of humanoid robot teaching system based on a RGB-D sensor *Chuntao Leng, Qixin Cao, Bo Fang, Yang Yang and Zhen Huang*

Session – E3: Sensing and Feature Extraction
Session Chair: Hernando Leon-Rodriguez

Date: Wednesday 17 July 2013	Time: 14.00 – 15.00	Venue: Jones Room

Time	Paper ID	Proc. Page	Presentation
14.00 – 14.20	70	351	E3.1 - CAMINANTE: A platform for sensitive walking *Vadim Chernyak, Ennio Clarretti, Stephen Nestinger and Euardo Torres-Jara*
14.20 – 14.40	36	815	E3.2 - Real-time detection of the activity of a dog *Germain Lemasson, Dominique Duhaut and Philippe Lucidarme*

14.40 – 15.00	61	77	E3.3 - Humanoid robot programming through face expressions *Alvaro Uribe, Hernando Leon-Rodriguez and Byron Perez*

Session – F3: Wheeled Systems Session Chair: Khaled M. Goher			
Date: Wednesday 17 July 2013		Time: 14.00 – 15.00	Venue: Broadway Room
Time	Paper ID	Proc. Page	Presentation
14.00 – 14.20	82	609	F3.1 - Design and locomotion modes of a small wheel-legged robot *Ioan Doroftei and Ion Ion*
14.20 – 14.40	58	479	F3.2 - Design of leaping behavior in a planar model with three compliant and rolling leg *Ya-Cheng Chou, Ke-Jung Huang, Wei-Shun Yu and Pei-Chun Lin*
14.40 – 15.00	110	133	F3.3 - Design of a reconfigurable wheelchair with a sit-to-stand facility for a disabled kid *K. M. Goher, S. Al-Harthi, M. Al-Rashdi, A. Al-Kindi, L. Al-Hadhrami, M. Shafiq, A. Al Yahmadi and S. Fadhallah*

15.00 – 15.20	**Tea Break**	Venue: Lobby

15.20 – 15.40	**Closure**	Venue: Harris, Jones, Broadway Rooms

15.40 –	Laboratory Tour Centre for Autonomous Systems, University of Technology, Sydney Australian Centre for Field Robotics, University of Sydney

Directions to Pier 26

Our banquet will be located on a harbor cruise boat. We will board at Pier 26, which is in an area called Darling Harbour. If you have had a chance to look around the city you may have visited the Sydney Aquarium. The boat will be moored right in front of the aquarium.

From the Building 10 lobby go out the front doors and turn left to walk the short distance to Thomas Street. Turn right on Thomas Street and follow it until it ends in Harris Street. Turn left on Harris Street and walk to the intersection with traffic lights. That is Ultimo Road. Turn right onto Ultimo Road and continue through the next set of traffic lights until you get to the second set of lights, which is Quay Street. You should have the UTS library on your left as you turn left into Quay Street. Walk down Quay Street until it ends in an open area. The building on your right houses Paddy's Market, which is a good, inexpensive place to shop for souvenirs etc.

Continue straight ahead and you will see a flight of steps going up to a monorail station. Go up the steps but do not go left toward the station. Going right takes you onto an elevated walkway past a parking garage on your left, and the Sydney Entertainment Centre on your right. At the end of the walkway continue on in the same direction under a highway viaduct. You should see the Sydney Convention Centre on your left as you continue toward a circular patch of grass with circular paths around both sides. This is called Tumbalong Park. It doesn't matter which side you go, but let's choose the left side that has a circular channel with fountains in the path. When you get to the other side of Tumbalong Park (diametrically opposite where you started) turn left along a straight path, also with a channel and fountains. You will see a large children's playground on your right. After passing the playground turn right up a couple of steps, and then left under a complex of highway viaducts past the Tourist Information Office to your right. You will see a body of water in front of you. That is called Cockle Bay. It is an extension of the inlet known as Darling Harbour.

Go along the walkway on the right side of Cockle Bay past a number of restaurants. You will see a bridge crossing the bay in front of you. That is Pyrmont Bridge. It is now a pedestrian bridge, having been replaced by the system of viaducts you walked under.

Walk under Pyrmont Bridge and Matilda III should be right in front of you. You will see the aquarium building on the other side of the mooring. We need to be ready to board at 7.15 pm for a 7.30 pm departure. The walk takes 25 to 30 minutes.

For those who do not wish to walk go right after leaving Building 10 to Broadway, and turn left to the bus stop in front of Building 1. Look for a 412, or 413 bus (Downtown/King Street Wharf). There is a 413 bus scheduled at 6.36 pm. Take this bus right to the end of the route (King Street Wharf). The official stop is in a little street called Cuthbert Place. It is scheduled to arrive at 6.57 pm. Some drivers don't want to stop there but prefer to pull around the corner into Lime St. Either way, you want the corner of Lime Street and Cuthbert Place. Walk down the stairs towards the water. You will see Sydney Wildlife World on your left. It's easily identified by the mesh aviary on the roof. Turn left along the boardwalk past Wildlife World. The walkway turns left past the aquarium, and you should see Matilda III right in front of you. Remember, you do need to purchase a bus ticket ahead of time from a newsagent, or the ticket office in Railway Square behind the bus shelters.

Also, be warned that Sydney buses rarely adhere closely to schedule. I would be at the bus stop at least five minutes ahead of time. If the bus does not appear before ten minutes after the scheduled time I would bail and flag down a taxi – pretty easy to do on Broadway.

After the cruise, those with hotels near UTS can return the same way. Darling Harbour hotels will be visible from the wharf. There is a taxi rank in Lime Street right behind Wildlife World for those who prefer that.