2014

IS-3T-in-3A

2014 International Symposium on InfoComm and Media Technology in Bio-Medical and Healthcare Application

Proceeding

December 21-24, 2014

Shanghai Jiao Tong University, Shanghai, China

http://robotics.sjtu.edu.cn/3Tin3A/

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Message from the Symposium Organizers

It gives us great pleasure to welcome you to the 2014 International Symposium on InfoComm & Media Technology in Bio-Medical & Healthcare Application (2014 IS-3T-in-3A) being held from December 21-24, 2014, at Shanghai Jiao Tong University, Shanghai, China.

This is the fourth version of IS-3T-in-3A after it was successfully held at Lijiang, Yunnan, China, Nishi-Chiba, Japan and Tao-Yuan, Taiwan in 2010, 2012 and 2013, respectively. The Symposium is jointly organized by Shanghai Jiao Tong University and Southeast University with the technical sponsorship of Chiba University, National University of Singapore, and Chang Gung University. The organization of this symposium is financially supported by Shanghai Jiao Tong University, National Hi-Tech Research and Development Plan (863 Program) and National Natural Science Foundation of China.

The aim of the symposium is to spur the collaborations between technology providers and adopters by establishing an international platform for exchanging knowledge about cross-disciplinary applications of information, communication, media and robot technology in biology, medicine and healthcare. As such, the inaugural symposium includes not only technical seminars but also plenty of opportunities for the participants from academia, research institutions, and companies to interact with one another.

The technical program of 2014 IS-3T-in-3A consists of 5 keynote speeches, 19 leading talks and 16 posters. The symposium also features 2 lab tours and a discussion in Minhang and Xuhui campuses, scheduled after the main technical program.

We would like to take this opportunity to thank the members of the Organizing Committee: Wenwei Yu, Chung-Chin Lin, Yu Qiao, Jingchuan Wang, Dongyun Gu, Yu Ge, Po-hsiang Tsui and et al. The high caliber of the symposium is a direct result of their wisdom and their hard work. We would be remiss in overlooking the very important role played by the member of secretariat and volunteers. Finally, we want to thank you, the speakers and participants, for your enthusiastic participation in the symposium. Welcome to Shanghai and enjoy 2014 IS-3T-in-3A.

Weidong Chen, General Chair

Shanghai Jiao Tong University

Xiaowei Zhu, Program Chair

Southeast University

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Detailed Technical Program

Day 1 December 21, 2014 (Sunday)	
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Day 2 December 22, 2014 (Monday)	
08:30~09:00	**Registration**
09:00~09:30	**Opening Ceremony (Chair: Weidong Chen)** Welcome speech: Junfa Mao, Dean, School of Electronic, Information and Electrical Engineering, Shanghai Jiao Tong University, China
09:30~10:50	**Keynote Speech (Chair: Weidong Chen)**
09:30~10:10	When Medical Mechatronics meets Wearable Technology Prof. Ming-yih Lee, Chang Gung University, Taiwan
10:10~10:50	Soft Robotics- the Next Generation of Intelligent Machines Prof. Rolf Pfeifer, Shanghai Jiao Tong University, China
10:50~11:10	**Tea Break**
11:10~12:10	**Leading Talk (Chair: Xiaowei Zhu)**
11:10~11:30	Master-Slave Gesture Learning System Based on Functional Electrical Stimulation Dr. Dingguo Zhang, Shanghai Jiao Tong University, China
11:30~11:50	Wearable Sensor System for Human-robot Interaction Prof. Tao Liu, Zhejiang University, China
11:50~12:10	Investigations of AMC and Its Applications for Performance Enhancement and Polarization Rotation of Antenna Arrays Prof. Wenquan Che, Nanjing University of Science and Technology, China
12:10~13:30	**Lunch**
13:30~14:50	**Keynote Speech (Chair: Wenwei Yu)**
13:30~14:10	Therapeutic Applications of Electromagnetic Waves Prof. Koichi Ito, Chiba University, Japan
14:10~14:50	Metamaterials-Based Coils in MRI Applications Prof. Zhi Ning Chen, National University of Singapore, Singapore

14:50~15:40	**Poster Session & Tea Break (Chair: Yu Qiao)**
P1	Physics-based Optimization Design of Broadband Folded Dipole Antennas through Manipulations on Smith Chart Yumei Chang, Nanjing University of Science and Technology, China
P2	A Sematic Map Based Approach for Seamless Interaction between Mobile Service Robot and Human Users Zhixuan Wei, Shanghai Jiao Tong University, China
P3	Evaluation on Heating Performances of Microwave Scalpel for Surgical Operation Kenta Suzuki, Chiba University, Japan
P4	SAR Evaluation of 1.2 GHz Band Wireless Camera Using A Tissue-equivalent Solid Phantom Tetsuya Yoshida, Chiba University, Japan
P5	Dual-band Diversity Antenna for Mobile Phone Diversity Antenna Qing Luo, Southeast University, China
P6	A Multiple-Sucker Manipulator for Intra-Abdominal Underwater Surgery Support Nobuto Tsuchiya, Chiba University, Japan
P7	Application of Visualization of Blood Vessel Based on Visual Feedback in Diagnosis of Vascular Disease Shouren Lan, Shanghai Jiao Tong University, China
P8	Assessment of Development and Growth Patterns of Autosomal Polycystic Kidney Disease of Kidney Using CT Images Yoshihisa Matsunaga, Chiba University, Japan
15:40~17:20	**Leading Talk (Chair: Wenquan Che)**
15:40~16:00	Priors based Medical Image Segmentation Prof. Xin Yang, Shanghai Jiao Tong University, China
16:00~16:20	Internet of Things for Smart Aging Prof. Wendong Xiao, University of Science and Technology Beijing, China
16:20~16:40	The Development of a Portable and Non-invasive Swallowing Assessment Approach Dr. Wann-Yun Shieh, Chang Gung University, Taiwan
16:40~17:00	Computer Assisted Surgery: Planning, Simulation, Template Guiding, and Navigation Dr. Xiaojun Chen, Shanghai Jiao Tong University, China
17:00~17:20	A Cable-driven Soft Robot for Minimally Invasive Surgery MD. Xiaozhou Wang, Shanghai Jiao Tong University, China
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Day 3 December 23, 2014 (Tuesday)	
09:00~09:40	**Keynote Speech (Chair: Zhi Ning Chen)**
09:00~09:40	Wireless Medical - An Important Application for IT Technologies - A Case Study for Computer Aided Orthopedic Surgery Prof. Zhihua Wang, Tsinghua University, China
09:40~10:40	**Leading Talk (Chair: Zhi Ning Chen)**
09:40~10:00	Soft Actuators with Biomedical Applications Dr. Jian Zhu, National University of Singapore, Singapore
10:00~10:20	Image Registration for Analysis of The Interrelation Between Pathological Image and MR Image of Brain Tumor Dr. Takashi Ohnishi, Chiba University, Japan
10:20~10:40	Patient Management-Future of Medical Device Dr. Simon Li, Covidien, China
10:40~11:30	**Poster Session & Tea Break (Chair: Yu Qiao)**
P1	Needle Tip Detection by Electro-Localization using a Phantom for a Needle Electromyogram Test Simulator Siyu He, Chiba University, Japan
P2	Quantitative Analysis of Prostate Cancer Using Ultrasonic Microscope Hiroaki Sugimoto, Chiba University, Japan
P3	Investigating the Effect of Synchronized Afferent Stimuli on Mirror Therapy Daito Tsujitani, Chiba University, Japan
P4	Detection and Quantitative Measurement Longitudinal Changes in Retinal Images Benzhi Chen, Shanghai Jiao Tong University, China
P5	Optical Flow Based Semi-Automatic Analysis of Ultrasound Images of Muscle Activation Shota Kawamoto, Chiba University, Japan
P6	Mental Workload Evaluation of Sensory Feedback Systems for Prosthetic Application Natsuki Hayata, Graduate School of Engineering, Chiba University, Japan
P7	Miniature Built-in Antenna at Low Frequency Xiaofang Tang, Southeast University, China
P8	A Virtual Simulation and Driver Evaluation Platform for Smart Wheelchairs Li Liu, Shanghai Jiao Tong University, China
11:30~12:10	**Leading Talk (Chair: Xin Yang)**

11:30~11:50	A Computer-aided Analysis System of Liver Structures with CT Dr. Yu Qiao, Shanghai Jiao Tong University, China
11:50~12:10	Effective Microwave Heating for Bile Duct Carcinoma under Metallic Stent Placement Dr. Kazuyuki Saito, Chiba University, Japan
12:10~13:30	**Lunch**
13:30~15:30	**Leading Talk (Chair: Tao Liu)**
13:30~13:50	Development of Computer-Aided Diagnosis System to Detect Lesions for Voiding Dysfunction using Cystourethroscopy Dr. Takuro Ishii, Chiba University, Japan
13:50~14:10	Novel Microstrip Bandpass Filter with Multiple Transmission Zeros UsingOpen/Shorted Stubs Dr. Wenjie Feng, Nanjing University of Science and Technology , China
14:10~14:30	Water-Filled Laparo-Endoscopic Surgery (WaFLES): Update Prof. Tatsuo Igarashi, Chiba University, Japan
14:30~14:50	An Electrical Cylinder Driven Exo-Skeleton Robot Dr. Jian Chen, Chinese Academy of Sciences, China
14:50~15:10	Developing At-home Assistive and Rehabilitative Systems Prof. Wenwei Yu, Chiba University, Japan
15:10~15:30	Application of 3D Printing Technology in Orthopedic Surgery Prof. Dongyun Gu, Shanghai Jiao Tong University, China
15:50~17:20	**Lab Tour (Chair: Jingchuan Wang)** School of Electronic, Information and Electrical Engineering, Minhang Campus, SJTU
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09:30~11:30	**Lab Tour & Discussion (Chair: Dongyun Gu)** Med-X Research Institute, and Engineering Research Center of Digital Medicine and Clinical Translation, Xuhui Campus, SJTU
11:30~13:00	**Lunch**

General Information

Venue

Conference Venue

The 2014 IS-3T-in-3A will be held at Shanghai Jiao Tong University, Minhang Campus, which situated in China's most modern city Shanghai with great influence over finance, commerce, fashion, and culture. The conference venue is sited in **room-200, Building-3, SEIEE(School of Electronic, Information and Electrical Engineering) Building,** located in Minhang Campus of SJTU. (No. 800, Dongchuan Road, Minhang District, Shanghai)

South Lian Hua Road
East Nan Yang Road
Wen Zhi Avenue
Long Pu Road
Shu Tong Road
Dong Chuan Road
Jian Chuan Road
Yuan Pei Road
Xue Sen Road
Wen Jun Road
Highway A4
Jing Qin Road
West Si Yuan Road
West Nan Yang Road
Cang Yuan Road

Travel Guide

Destinations:

1. **Minhang Campus of Shanghai Jiao Tong University (No. 800, Dongchuan Road, Minhang District)**
2. **Shanghai Huhua International Hotel (No.300 Heqing Road, Minhang District)**

A: From Pudong International Airport

- Public Transportation

Metro Line 2→→Metro Line 1 (People's Square)→→Metro Line 5 (Xin-Zhuang) →→Dong-Chuan Road (Take a taxi about 10 Mins' Ride, 12RMB) →→Minhang Campus of SJTU or Huhua International Hotel

- Taxi

About 50 km, Around 200RMB

B: From Hongqiao Airport/Shanghai Hongqiao Railway Station

- Public Transportation 1

Bus Hong-Qiao-Shu-Niu 4→→Dong-Chuan Road, Yong-Pin Road→→Minhang Campus of SJTU;

Bus Hong-Qiao-Shu-Niu 4 (East Hong-Qiao Transportation Center) →→Hu-Min Road, Dong-Chuan Road (Take a taxi about 10 Mins' Ride, 12RMB) →→Huhua International Hotel

- Public Transportation 2

Metro Line 2→→Metro Line 1 (People's Square) →→Metro Line 5 (Xin-Zhuang) →→Dong-Chuan Road (Take a taxi about 10 Mins' Ride, 12RMB) →→Minhang Campus of SJTU or Huhua International Hotel

- Taxi

About 30 km, Around 100RMB

C: From Shanghai Railway Station

- Public Transportation

Metro Line 1→→Metro Line 5 (Xin-Zhuang) →→Dong-Chuan Road (Take a taxi about 10 Mins'Ride, 12RMB) →→Minhang Campus of SJTU &or Huhua International Hotel

- Taxi

About 30 km, Around 100RMB

D: From South Shanghai Railway Station

- Public Transportation

Bus 180→→SJTU East Campus Station (Dong-Chuan Road, Yong-Pin Road) →→Minhang Campus of SJTU (Another 5 Mins' Ride by Taxi →→Huhua International Hotel)

- Taxi

About 20 km, Around 80RMB

Notes:

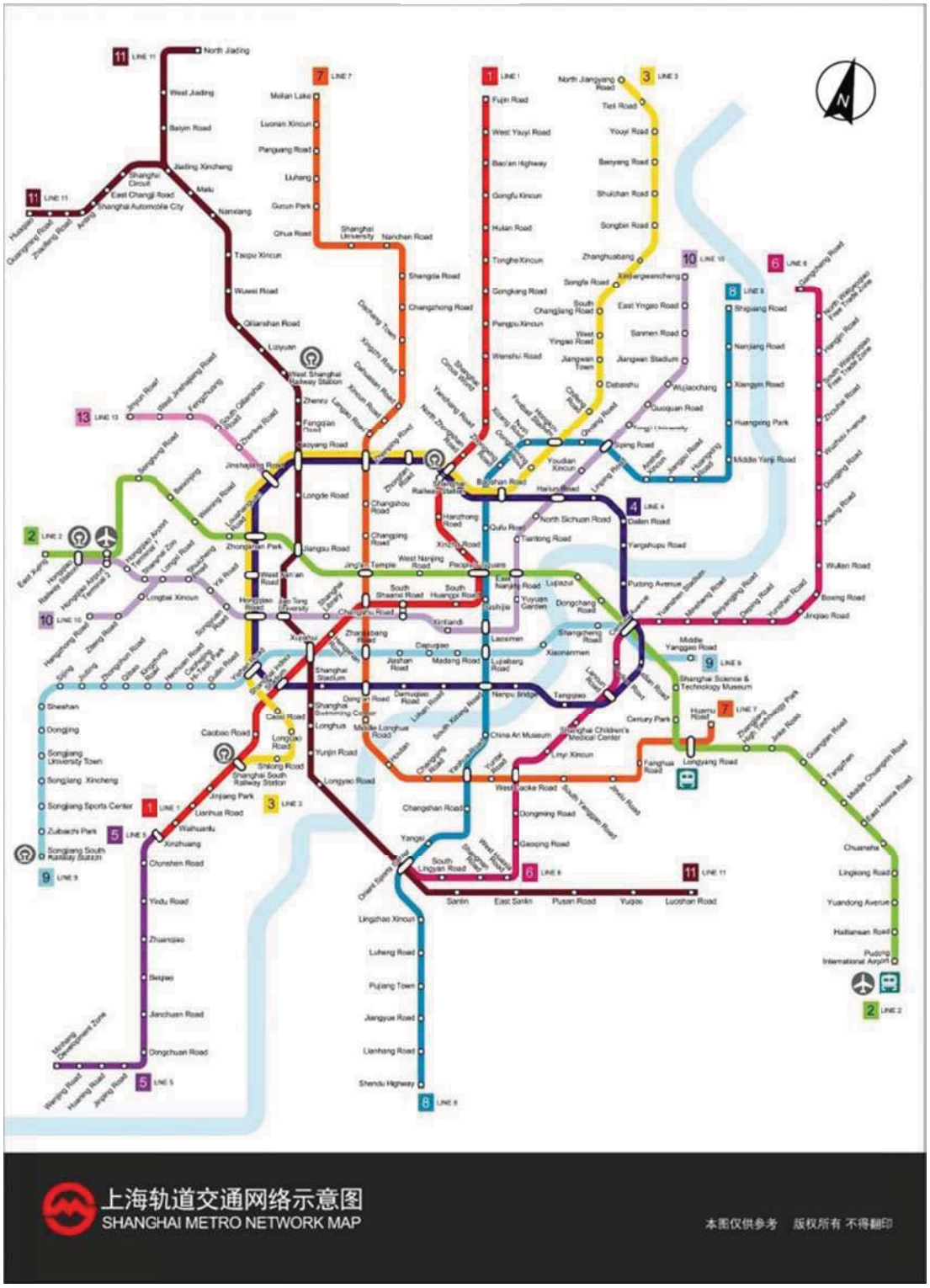
- Public Transportation Operation hours:

Metro Line 1, 05:30-22:30
Metro Line 2, 06:30-21:00 (Pudong International Airport→→Xu-Jing-Dong) & 05:30-22:45 (Hongqiao Airport/Hongqiao Railway Station→→Pudong International Airport)
Metro Line 5, 06:00-22:30
Bus Hong-Qiao-Shu-Niu 4, 06:00-22:30
Bus Chuan-Feng-Zhuan-Xian, 05:00-19:00
Bus Xin-Tuan-Xian, 06:30-16:30

- For more detailed information on Shanghai Metro, you may visit:

Shanghai Metro: http://www.shmetro.com/EnglishPage/EnglishPage.jsp

- Shanghai Metro Network Map has been included for your reference:



Organization Committee

International Advisory Committee

Koichi Ito (co-Chair), Chiba University
Zhi Ning Chen (co-Chair), National University of Singapore
Ming-yih Lee (co-Chair), Chang Gung University

Organizing Committee

Weidong Chen (General Chair), Shanghai Jiao Tong University

Technical Program Committee

Xiaowei Zhu (Chair), Southeast University
Wenwei Yu (co-Chair), Chiba University
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Yuesheng Zhu, Peking University
Wenquan Che, Nanjing University of Science and Technology
Xianming Qing, Institute for Infocomm Research, A*Star
Yu Ge, Institute for Infocomm Research, A*Star
Zhihua Wang, Tsinghua University
Velan Sambasivam Sendhil, Singapore Bioimaging Consortium, A*Star
Zhigong Wang, Southeast University
Huan Bang Li, National Institute of Information and Communications Technology
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Kazuyuki Saito, Chiba University
Peter Weiliang Xu, The University of Auckland
Lisheng Wang, Shanghai Jiao Tong University
Tao He, Shanghai Jiao Tong University

Publicity Committee

Yu Qiao (Chair), Shanghai Jiao Tong University
Jingchuan Wang (co-Chair), Shanghai Jiao Tong University

Regional Liaisons

Wenwei Yu, Chiba University
Dongyun Gu, Shanghai Jiao Tong University
Yu Ge, Institute for Infocomm Research, A*Star
Po-hsiangTsui, Chang Gung University

Keynote Speech

December 22, 2014 (Monday)

09:30~10:10	When Medical Mechatronics meets Wearable Technology Prof. Ming-yih Lee, Chang Gung University, Taiwan
10:10~10:50	Soft Robotics- the Next Generation of Intelligent Machines Prof. Rolf Pfeifer, Shanghai Jiao Tong University, China
13:30~14:10	Therapeutic Applications of Electromagnetic Waves Prof. Koichi Ito, Chiba University, Japan
14:10~14:50	Metamaterials-Based Coils in MRI Applications Prof. Zhining Chen, National University of Singapore, Singapore

December 23, 2014 (Tuesday)

09:00~09:40	Wireless Medical - An Important Application for IT Technologies - A Case Study for Computer Aided Orthopedic Surgery Prof. Zhihua Wang, Tsinghua University, China

When Medical Mechatronics meets Wearable Technology

Ming-yih Lee

Professor and Chair
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In this talk, the challenge of aging population and new thoughts of healthy aging will be introduced. Recently, the medical mechatronics technologies used for medical device innovation is shifting to new directions for enabling the human functions and identifying the earliest markers of age related diseases. By merging wearable technology, the wearable "rigid" Medical Mechatronics (WRMM) and wearable "soft" Medical Mechatronics (WSMM) for bio-medical and health engineering applications will be defined. The exoskeleton bionic devices / systems and smart textiles / clothes for bio-medical and health applications will be elaborated. Open research areas in wearable medical mechatronics will be suggested.

Biographic sketch

Ming-yih Lee, Ph.D.

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Education & Training

1991 Ph.D. of Department of Mechanical Engineering, University of Minnesota, USA
1984 M.S. of Department of Mechanical Engineering, University of Minnesota, USA

Professional memberships

Fellow, IET, Member, IEEE

Selected papers

[1] C.H.Chen, Victor B.H.Shyu, J.P.Chen and **M.Y.Lee** (**corresponding author**), 2014," Selective Laser Sintered Poly (ε-caprolactone) Scaffold Hybridized With Collagen Gel for Cartilage Tissue Engineering," Biofabrication, DOI: 10.1088/1758-5082/6/1/015004, January 2014 (SCI; IF=3.705; Rank 8/79 in Engineering, Biomedical).

[2] H.T.Liao, **M.Y.Lee** (**corresponding author**), W.W.Tsai, H.C.Wang, W.C.Lu, 2013, "Osteogenesis Of Adipose-Derived Stem Cells On Polycaprolactone/β-Tricalcium Phosphate Scaffold Fabricated Via Selective Laser Sintering And Surface Coating With Collagen Type I,"J of Tissue Engineering and Regenerative Medicine, DOI: No.10.1002/term.1811, July 2013 (SCI; IF=2.826; Rank 14/79 in Engineering, Biomedical).

[3] **M.Y.Lee**, W.W.Tsai, Z.H.Tang, H.J.Chen, J.P.Chen, C.H.Chen, J.An, 2013,"Laser sintered porous polycaprolacone scaffolds loaded with hyaluronic acid and gelatin-grafted thermoresponsive hydrogel for cartilage tissue engineering," Bio-Medical Materials and Engineering, DOI: 10.3233/BME-130767, May 2013 (SCI; IF=1.087;Rank 58/79 in Engineering, Biomedical).

[4] M.Y. Wu, **M.Y. Lee**, C.C. Lin, Y.S. Changa, F.C. Tsai, P.J. Lin, 2012,"Resuscitation of Non-Postcardiotomy Cardiogenic Shock rr Cardiac Arrest with Extracorporeal Life Support: the Role of Bridging to Intervention", Resuscitation, Vol. 83, pp.976-981, Jan. 2012.(SCI; IF=4.104; Rank 2/25 in Emergency Medicine).

[5] **M.Y.Lee**, S.W. Liu, J.P.Chen, H.T. Laio, W.W.Tsai and H.C. Wang, 2011,"In vitro experiments on laser sintered porous PCL scaffolds with polymer hydrogel for bone repair," Journal of Mechanics in Medicine and Biology (JMMB), Vol.11, No.5, pp.983-992, Dec. 2011, DOI:10.1142/S0219519411004885 (SCI; IF=0.758; Rank 63/79 in Engineering, Biomedical).

[6] W.W. Tsai, **M.Y.Lee** (**corresponding author**), W.L. Yeh, S.C. Cheng, K.S. Soon, K.F. Lei, W.Y. Lin, 2011, "A Quantitative Method for Evaluating Inferior Glenohumeral Joint Stiffness Using Ultrasonography," Medical Engineering & Physics (MEP), DOI:10.1016/j.medengphy.2011.10.007,Vol.35, pp.236-240, October 2011 (SCI; IF=1.779;Rank 34/79 in Engineering, Biomedical).

Soft robotics – the next generation of intelligent machines

Rolf Pfeifer

Visiting Chair Professor
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Shanghai Jiao Tong University

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Over the past decade or so, robots have started to leave the factory floors and to move into our own living space – shopping centers, schools, downtown areas, homes, and hospitals – which, in contrast to manufacturing sites, are characterized by rapid changes and limited predictability. Because safety, reactivity, and adaptivity are key factors in such environments, in particular in the medical and assistive domains, the next generation of robots will be of the "soft" kind, literally soft to touch, but also soft, smooth, and agreeable in the interaction. This requires a fundamentally new conceptualization of intelligence based on the notion of "embodiment". "Embodiment" designates the insight that intelligence is not localized in the brain, but emerges from the interaction between brain, body and environment. This is especially important for soft systems because there part of the functionality is incorporated into the material properties, a phenomenon called "morphological computation." In the presentation these ideas will be elaborated with many examples, including Roboy, a prominent representative of the soft robot species. I will conclude with a summary of some recent trends in robotics.

Biographic sketch

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Rolf Pfeifer is currently a “Visiting Chair Professor,” at Shanghai Jiao Tong University, China. He is a member of the board of several Artifical Intelligence and Robotics companies, co-founder the National Competence Center Robotics, Switzerland, and Prof. em. of the Artificial Intelligence Laboratory, University of Zurich.

He has a master’s degree in physics and mathematics and a Ph.D. in computer science (1979) from the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland. From 1987-2014 he was a professor of computer science at the University of Zurich and director of the Artificial Intelligence Laboratory. He was a visiting professor and research fellow at the Free University of Brussels, the MIT Artificial Intelligence Laboratory in Cambridge, Mass. (US), the Neurosciences Institute (NSI) in San Diego, the Beijing Open Laboratory for Cognitive Science, the Ludwig-Maximilians-University, Munich, the University of São Paolo, Brasil, and the Sony Computer Science Laboratory in Paris. In 2004 he was elected "21st Century COE Professor, Information Science and Technology, Strategic Core" at the University of Tokyo. In 2009 he was a visiting professor at the Scuola Superiore Sant'Anna in Pisa, and at Shanghai Jiao Tong University in China and was appointed "Fellow of the School of Engineering" at the University of Tokyo.

He is a pioneer of the fields of “embodied intelligence” and “soft robotics” which are now rapidly gaining importance and have already had a decisive impact on of artificial intelligence and robotics. His book “How the body shapes the way we think” has been published in English, Japanese, Chinese, Arabaic, and French. He developed the humanoid robot “Roboy,” which has attracted world-wide media attention, and he is currently pursuing the “Robolounge” project, where robots will take care of the well-being of the customers, to be launched in an Asian metropolis in 2015/2016.

Therapeutic Applications of Electromagnetic Waves

Koichi Ito

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In recent years, various types of medical applications of electromagnetic waves have widely been investigated and reported. Typical recent applications include:

(1) Information transmission:
- RFID (Radio Frequency Identification) / Wearable or Implantable monitor
- Wireless telemedicine / Mobile health system
(2) Diagnosis:
- High intensity MRI (Magnetic Resonance Imaging)
- Microwave CT (Computed Tomography) / Radiometry
(3) Treatment:
- Thermal therapy (Hyperthermia, ablation, etc)
- Surgical device (Coagulation device, microwave knife, etc)

In this presentation, microwave techniques for medical treatment, which employ thermal effect of electromagnetic waves, are introduced. Firstly, a coaxial-slot antenna and an array applicator composed of several coaxial-slot antennas for minimally invasive microwave thermal therapy are overviewed. A few results of actual clinical trials by use of coaxial-slot antennas are demonstrated from a technical point of view. Other therapeutic applications of coaxial-slot antennas such as hyperthermic treatment for brain tumor and intracavitary hyperthermia for bile duct carcinoma are also briefly introduced. Secondly, a few different types of surgical devices using high power microwave energy, including a new coagulation device which has two functions of coagulating and cutting biological tissue, are introduced. Heating characteristics of such microwave surgical devices are evaluated by numerical calculation and some experiments.

Biographic sketch

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Education & Training

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Professional memberships

2007 Fellow, IEICE (Japan)
2005 Fellow, IEEE
1987 Member, Japanese Society for Thermal Medicine

Selected papers

[1] Mizuki Inoue, Kazuyuki Saito, Masa haru Takahashi, and Koichi Ito, “Development of Coagulation Device for Biological T issue using Microwave E nergy, ” IEICE Transactions on Communications C, vol.J97-C, no.5, pp.218-224, May 2014.
[2] Shogo Tsuzaki, Kazuyuki Saito, Masaharu T akahashi, and Koichi Ito, "Developm ent of antenna for wireless power transmission to capsular endoscope," IEICE Communications Express, vol.3, No.4 pp.138-143, Apr. 2014.
[3] Ho-Yu Lin, Masaharu T akahashi, Kazuyuki Sa ito, and Koichi Ito, “Characteristics of electric field and radiation pattern on dif ferent locations of the hum an body for in-body wireless communication,” IEEE Transactions on Antennas and Propagation, vol.61, no.10, pp.5350-5354, Oct. 2013.
[4] Nozomi Haga, Kazuyuki Saito, Masaharu Takahashi, and Koichi Ito, “Equivalent circuit of intrabody communication channels induc ing conduction currents inside the hum an body,” IEEE T ransactions on Antennas a nd Propagation, vol.61, no.5, pp.2807-2816, May 2013.
[5] Chia-Hsien Lin, Kazuyuki Saito, Masaharu Takahashi, and Koichi Ito, “A Compact Planar Inverted-F Antenna for 2.45 GHz On-Body Communications,” IEEE Transactions on Antennas and Propagation, vol.60, no.9, pp.4422-4426, Sept. 2012.
[6] Koichi Ito, Nozom i Haga, Masaharu T akahashi, and Kazuyuki Saito, “Evaluations of Body-Centric Wireless Communication Channels in a Range From 3MHz to 3 GHz,” Proceedings of the IEEE, vol. 100, no. 7, pp. 2356-2363, July 2012.
[7] Nacer Chahat, Maxim Zhadobov, Ronan Saul eau, and Koichi Ito, "A compact UWB antenna for on-body applications," IEEE Tr ansactions on Antennas and Propagation, vol.59, no.4, pp.1123-1131, Apr. 2011.

Metamaterials-Based Coils in MRI Applications

Zhi Ning Chen

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Institute for Infocomm Research, Agency for Science, Technology and Research, Singapore
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Purpose:
This talk will review and report the latest progress in the coil designs for magnetic resonance imaging (MRI) systems using the latest developed metamaterial-based technology.

Methods:
In MRI systems, the design of coils is important for a high resolution imaging. The coils play an important role as a sensor to collect the radio frequency signals for imaging process. Conventionally, the coils have been designed a solid loop or loops. Enhancing the magnetic field strength by designing the coils can increase the signal to noise ratio so that the resolution of imaging will be enhanced. On the other hand, metamaterials as a new physical concept, have recently been proposed to realize unique electromagnetic (EM) properties which are not readily found in any natural materials. Using metamaterials, the magnetic field can be controlled for desired distribution. Therefore, it is very promising for us to introduce the metamaterials-based technologies in coil designs for the enhancement of MRI systems.

Results:
So far, the metamaterials structures have been used in enhancing the strength of near-magnetic field of single loop and arrays as a reflector or/and lens as well as a magnetic field relay. The clinic test has verified this enhancement.

Conclusions:
The coil is one of the most important designs in MRI system for high resolution. The recent work has clearly demonstrated that the applications of the physical concept of metamaterials will open a new window for developing innovative coils. The metamaterials-based structure can be used as reflectors, lens and relays for controlling the magnetic fields in near-field zones.

Challenges and future requirements:
The major technical challenges to apply metamaterials-based technologies in the design of coils for MRI systems include

A. The specific metamaterials design for desired EM properties such negative index, zero index even high permeability with very low ohmic loss at radio frequencies;
B. Clearly defined requirements for the coils for particular applications; and
C. The integration of the metamaterials-based coils into MRI circuits for performance enhancement at a system level.

The work has been significantly contributed by Dr Xianming Qing, Dr S. Sendhil Velan, Dr Siew Bee Yeap and Dr Mei Sun from Agency of Science, Technology and Research (A*Star), Singapore, financially supported by the project entitled “Metamaterial-based RF coils for MRI” funded by A*Star Joint Council Office Grant (ID No: 1331A003)

Biographic Sketch

Zhi Ning Chen, Ph.Ds

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Education & Training

2003 D. Eng. of Electrical Engineering, University of Tsukuba, Japan
1993 D. Eng. of Electrical Engineering, Institute of Communications Engineering, China
1988 M. Eng. of Electrical Engineering, Institute of Communications Engineering, China
1985 B. Eng. of Electrical Engineering, Institute of Communications Engineering, China

Professional memberships

2007 Fellow, IEEE

Selected papers

[1] Nasimuddin, Z. N. Chen, and X. Qing, "Substr ate integrated metamat erial-based leaky wave antenna with im proved boresight radiation bandwidth," ***IEEE Antennas and Propagation Magazine***, vol. 61, no. 7, pp. 3451-3457, July 2013

[2] Nasimuddin, Z. N. Chen, and X. Qing, "Slotted microstrip antennas for circular polarization with compact size," ***IEEE Antennas and Propagation Magazine***, vol.61, no.2, pp.124-137, April 2013

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[4] J. Xu, Z. N. Chen, and X. Qing, "140-GHz TE $_{20}$-Mode Dielectric-Loaded SIW Slot Antenna Array in LTCC," ***IEEE Trans. Antennas Propagat.***, vol.61, no.4 (Part I), pp .1784-1793, April 2013

[5] J. Xu, Z. N. Chen, and X. Qing, "270-GHz L TCC-Integrated High Gain Cavity -Backed Fresnel Zone Plate Lens Antenna," ***IEEE Trans. Antennas Propagat.***, vol.61, no.4 (Part I) , pp.1679-1687, April 2013

[6] M. Sun, X. Qing, and Z. N. Chen, "Gain Enhanc ement of 60- GHz Antipodal T apered Slot Antenna Using Zero-Index Metamaterial," ***IEEE Trans. Antennas Propagat.***, vol.61, no.4 (Part I), pp.1741-1746, April 2013

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Wireless medical - an important application for IT technologies
- A Case study for computer aided orthopedic surgery

Abstract:

With the improvement of medical and living standards, the extension of human life rapidly, population aging society is accelerating. Information services, medical and health care will certainly be combined to change the way people live. In the same time, the information industry, medical and health care service themselves are bring about change. This report started with the comparison of the semiconductor and the medical device industry market, illustrating the medical applications will be an important direction of integrated circuits and system design and IT technologies. Began at discussion of the information services on the Internet, the necessary requirements to provide mobile medical and healthcare services are proposed witch are the accurate, reliable and complete (ARC) ways to make measurement of life and health information could been provided. Further suggestions to achieve such ARC comprehensive measurements of the life and health information in home and a mobile environment are to make medical devices miniaturization, intelligence and electrify.

The case studies for computer aided orthopedic surgery are described including the integrated circuit design for the monitoring of the total knee and hip replacement surgeries. A few references are given in the tutorial including papers and patents.

Biographic sketch

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Selected papers

Journal Papers Cited by Science Citation Index
1. IEEE Journal OF SOLID-STATE CIRCUITS (JSSC) – (7 papers)
2. Papers published on IEEE Transactions - (22 papers)
3. Other Journal papers Cited by Science Citation Index (SCI) – (60 papers)

International Conference papers
1. ISSCC – IEEE International Solid-State Circuits Conference - (5 papers)
2. CICC – IEEE Custom Integrated Circuits Conference– (10 papers)
3. A-SSCC – IEEE Asian Solid-State Circuits Conference – (25 papers)
4. RFIC – IEEE Radio Frequency Integrated Circuits Symposium – (11 papers)
5. ISCAS – IEEE International Symposium on Circuits and Systems - (61 papers)
6. Other international conference papers – (206 papers)

Selected Books
1. Zhihua Wang, Hanjun Jiang, Hong Chen, CMOS IC Design for Wireless Medical and Health Care, (ISBN: 978-1-4614-9502-4), Springer Press, 2013
2. Nianxiong Nick Tan, Dongmei Li, Zhihua Wang (Editors), Ultra-Low Power Integrated Circuit Design - Circuits, Systems, and Applications, (ISBN 978-1-4419-9972-6), Springer Press, 2014
3. Tianjia Sun, Xiang Xie, Zhihua Wang, Wireless Power Transfer for Medical Microsystems (ISBN: 978-1-4614-7701-3), Springer Press, 2013

Leading Talk

December 22, 2014 (Monday)

11:10~11:30	Master-Slave Gesture Learning System Based on Functional Electrical Stimulation Dr. Dingguo Zhang, Shanghai Jiao Tong University, China
11:30~11:50	Wearable Sensor System for Human-robot Interaction Prof. Tao Liu, Zhejiang University, China
11:50~12:10	Investigations of AMC and Its Applications for Performance Enhancement and Polarization Rotation of Antenna Arrays Prof. Wenquan Che, Nanjing University of Science and Technology, China
15:40~16:00	Priors based Medical Image Segmentation Prof. Xin Yang, Shanghai Jiao Tong University, China
16:00~16:20	Internet of Things for Smart Aging Prof. Wendong Xiao, University of Science and Technology Beijing, China
16:20~16:40	The Development of a Portable and Non-invasive Swallowing Assessment Approach Dr. Wann-Yun Shieh, Chang Gung University, Taiwan
16:40~17:00	Computer Assisted Surgery: Planning, Simulation, Template Guiding, and Navigation Dr. Xiaojun Chen, Shanghai Jiao Tong University, China
17:00~17:20	A Cable-driven Soft Robot for Minimally Invasive Surgery MD. Xiaozhou Wang, Shanghai Jiao Tong University, China

December 23, 2014 (Tuesday)

09:40~10:00	Soft Actuators with Biomedical Applications Dr. Jian Zhu, National University of Singapore, Singapore
10:00~10:20	Image Registration for Analysis of The Interrelation Between Pathological Image and MR Image of Brain Tumor Dr. Takashi Ohnishi, Chiba University, Japan
10:20~10:40	Patient Management-Future of Medical Device Dr. Simon Li, Covidien, China
11:30~11:50	A Computer-aided Analysis System of Liver Structures with CT Dr. Yu Qiao, Shanghai Jiao Tong University, China
11:50~12:10	Effective Microwave Heating for Bile Duct Carcinoma under Metallic Stent Placement Dr. Kazuyuki Saito, Chiba University, Japan
13:30~13:50	Development of Computer-Aided Diagnosis System to Detect Lesions for Voiding Dysfunction using Cystourethroscopy Dr. Takuro Ishii, Chiba University, Japan
13:50~14:10	Novel Microstrip Bandpass Filter with Multiple Transmission Zeros Using Open/Shorted Stubs Dr. Wenjie Feng, Nanjing University of Science and Technology, China
14:10~14:30	Water-Filled Laparo-Endoscopic Surgery (WaFLES): Update Prof. Tatsuo Igarashi, Chiba University, Japan
14:30~14:50	An Electrical Cylinder Driven Exo-Skeleton Robot Dr. Jian Chen, Chinese Academy of Sciences, China
14:50~15:10	Developing At-home Assistive and Rehabilitative Systems Prof. Wenwei Yu, Chiba University, Japan
15:10~15:30	Application of 3D Printing Technology in Orthopedic Surgery Prof. Dongyun Gu, Shanghai Jiao Tong University, China

Master-Slave Gesture Learning System Based on Functional Electrical Stimulation

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Purpose:
For a regular beginner in learning dexterous skills of hands, for example, playing musical instrument, it's challenging to imitate the hand movement of the teacher due to unfamiliarity with both the fingering and the music piece. Commonly, beginners have no other choice but keep practicing the music piece over and over again, which is rather time-consuming. Based on a technique termed functional electrical stimulation (FES), we developed a master-slave gesture learning system with wearable devices to help solve this problem. This proposed system can also be used for some medical purposes, such as sign language learning and stroke rehabilitation.

Methods:
We developed the master-slave gesture learning system based on the technique of FES, where the multi-pad FES system with a 20-pad electrode array was utilized to stimulate the targeted muscle groups accurately. In terms of determining stimulation parameters, we designed a procedure and used a wearable surface-electromyography (sEMG) acquisition device, SJU-iMYO, to obtain sEMG signal on the master side (teacher). Afterwards we used an algorithm to determine the electrode set to activate and the correspondent current intensity on the slave side (student) automatically. Fig. 1 shows the structure of the proposed master-slave gesture learning system, which consists mainly of two parts, i.e. the master unit and slave unit. The master unit was the part that identified the hand movement of the master side by processing the sEMG signal into recognizable movement patterns. The slave unit was the part that implemented finger movement by applying electrical currents to the specific electrode subset on the slave side based on orders from PC.

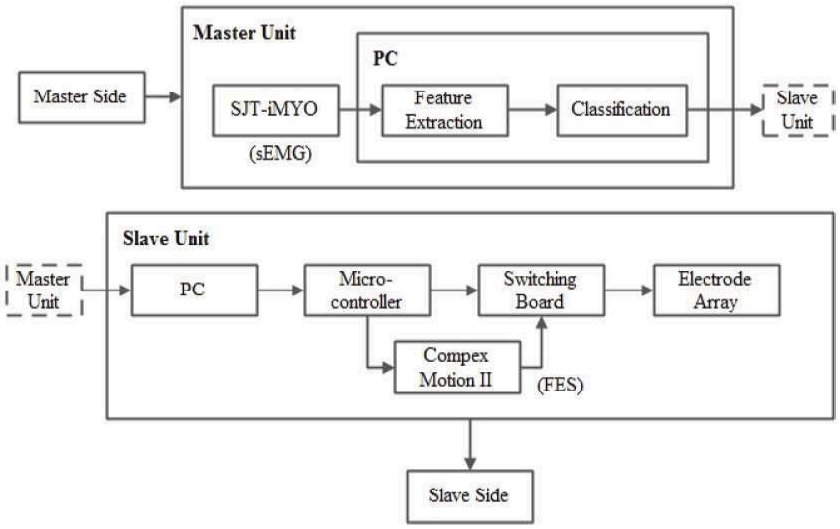

Fig. 1: System structure of the proposed master-slave gesture learning system

Results:
Four healthy subjects participated in this experiment. In the master side, the result showed

that the average accuracy of each selected finger movement pattern was higher than 90%, which indicated a latent capacity for realistic application. In the slave side, it could be found that six different finger movement patterns appeared in all 4 subjects' test. The result indicated that we were able to achieve independent finger movement control of the thumb, the index finger, the middle finger and the ring finger, but except for the little finger whose movement was always accompanied with the other fingers (the middle finger or the ring finger). The prototype demonstration is shown in Fig.2.

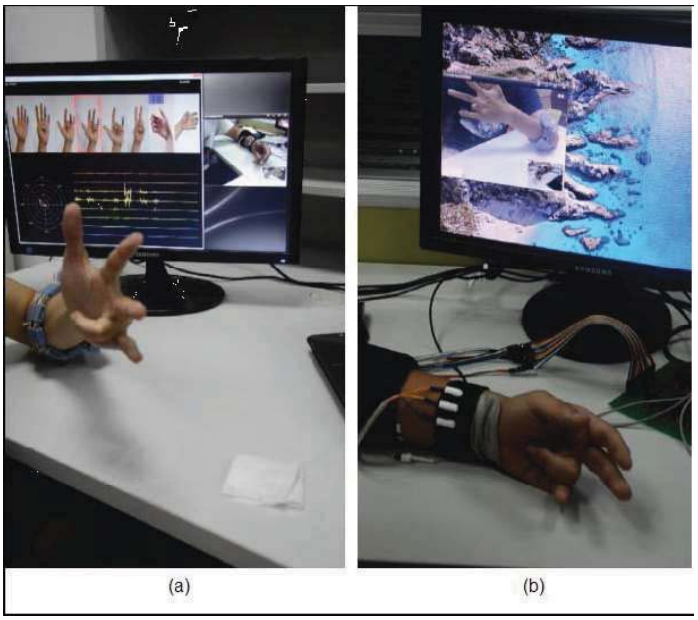

Fig.2 Demonstration of the gesture learning prototype with master-slave control
(a) The master side; (b) The slave side.

Conclusions:

In this work, we developed the prototype of master-slave gesture learning teaching system based on FES, which is capable of selecting optimal electrode subset automatically and achieving master-slave control in finger movement imitation. To assess the performance of the device, several experiments were conducted on four subjects. All results indicated that our system succeeded in imitating the movement of each finger with fairly good accuracy, except for the little finger.

Challenges and future requirements:

Further work might include improvement of the multi-pad FES system by reducing the area of each electrode pad and increasing the number of electrodes appropriately, or by replacing the solid-gel electric pads with silver/silver-chloride electrode pads to enable independent movement control of the little finger. Moreover, some clinical applications in sign language learning and stroke rehabilitation will be conducted.

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Work Experience:

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- Postdoctoral Fellow, Robotics Department, LIRMM of CNRS and UM II, France, Jan. 2008 - Nov. 2008.
- Research Fellow, BioRobotics Lab, Nanyang Technological University, Singapore, Jun. 2007 - Jan. 2008.
- Research Associate, BioRobotics Lab, Nanyang Technological University, Singapore, Jan. 2006 - May. 2007.

Research Interests:

Human-Machine Interface, Rehabilitation Technique, Functional Electrical Stimulation, Biological Cybernetics

Academic Services:

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Selected Papers:

1. **Zhang DG**, Zhang Q, Zhu XY, Exploring A Type of Central Pattern Generator Based on Hindmarsh-Rose Model: From Theory to Application, *International Journal of Neural Systems*, Accepted , 2014
2. Pan LZ, **Zhang DG**, Liu JW, Sheng XJ, Zhu XY, Continuous Estimation of Finger Joint Angles under Different Static Wrist Motions from Surface EMG Signals, *Biomedical Signal Processing and Control*, Accepted , 2014
3. Liu JW, **Zhang DG**, Sheng XJ, Zhu XY, Quantification and Solutions of Arm Movements Effect on sEMG Pattern Recognition, *Biomedical Signal Processing and Control*, 01, 189-197 , 2014
4. He JY, **Zhang DG**, Sheng XJ, Li SC, Zhu XY, Invariant Surface EMG Feature Against Varying Contraction Level for Myoelectric Control Based on Muscle Coordination, *IEEE*

Journal of Biomedical and Health Informatics, Accepted , 2014
5. Chen XP, **Zhang DG**, Zhu XY, Application of a Self-enhancing Classification Method to Electromyography Pattern Recognition for Multifunctional Prosthesis Control, *Journal of NeuroEngineering and Rehabilitation*, 10(1), art no.44, 2013.
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8. Yao L, Meng JJ, **Zhang DG**, Sheng XJ, Zhu XY, Selective Sensation Based Brain-Computer Interface via Mechanical Vibrotactile Stimulation, *PLOS ONE*, 2013

Wearable Sensor System for Human-robot Interaction

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Purpose:

The method based on a combination of high-speed cameras for capturing the three-dimensional (3D) orientations of human body segments and stationary force plates for measuring ground reaction force (GRF) has been widely used for human dynamics analysis in the laboratory environments. However, the applications of these stationary devices are restricted to experimental research, and it is difficult to find applications of the gait analysis in daily life environments or clinics. To implement the real-time control and online evaluation in human-robot interaction, we developed a wearable sensor system to estimate triaxial joint moments and forces of the ankle, knee and hip joints.

Methods:

As shown in Fig. 1, five motion sensors were used to acquire the 3D joint angles of the lower limbs and waist. Accelerometer, gyroscope and magnetic sensor were integrated in the motion sensor units. Sensor data were transmitted to the personal computer via a wireless local area network (WLAN). In addition, three mobile force plates were mounted under each shoe and each force plate can measure the triaxial GRF and triaxial moment of the corresponding segment (see Fig. 2). Triaxial joint moments and forces of the ankle, knee and hip joints were calculated using measurements of the wearable sensor system.

Fig. 1 Wearable sensor system

Fig. 2 Three mobile force plates in a shoe

Results:

A comparison of the developed system and the reference system for the three lower limb joints of ankle joint (a)-(c), knee joint (d)-(f) and hip joint (g)-(i) moments is presented in Fig. 3. The vertical axes indicate the joint moments normalized to body mass (Nm/kg), while the horizontal axes represent the percentage of stride (%). Table 1 gives the comparison between triaxial joint moments measured by the developed system and the reference system expressed as both NRMSE (%) and correlation coefficient (R) for the four subjects in all experiment trials. The ankle joint moments and the knee joint moments measured by the developed system compared to the reference system showed NRMSE<14 and R>0.90, and the hip joint moments showed NRMSE<22 and R>0.80 (Table I). Moreover, we compared the joint moments results using the developed system with the traditional method's results reported in the literature.

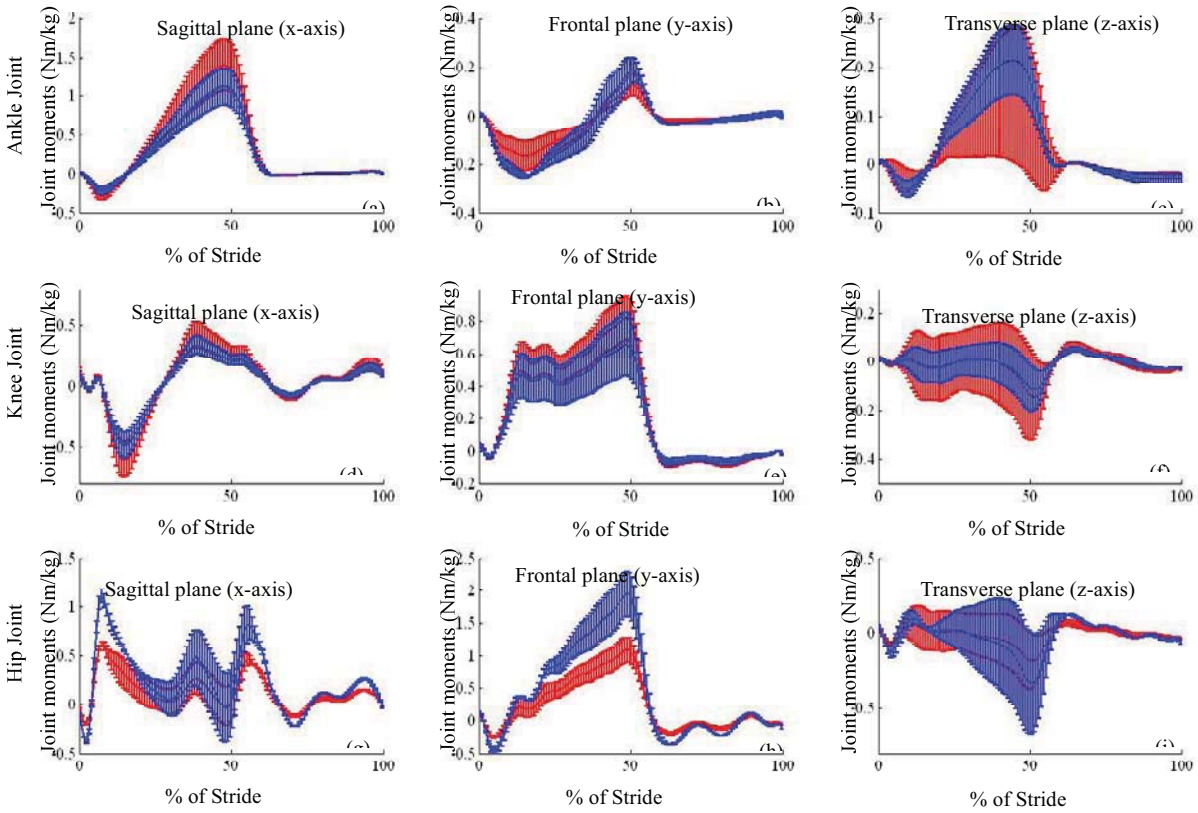

Figure 3 Validation results of triaxial joint moments by comparing the developed system (red) with a reference measurement system (blue). Standard deviations above and below the mean values are presented for the four

Table 1 THE COMPARISON BETWEEN TRIAXIAL JOINT MOMENTS MEASURED BY THE DEVELOPED SYSTEM AND THE REFERENCE SYSTEM.

	M_x^{Ankle}	M_y^{Ankle}	M_z^{Ankle}	M_x^{Knee}	M_y^{Knee}	M_z^{Knee}	M_x^{Hip}	M_y^{Hip}	M_z^{Hip}
NRMSE (%)	3.5	6.7	7.1	4.1	13.4	9.5	21.0	15.3	19.3
R	0.97	0.99	0.95	0.99	0.98	0.96	0.91	0.81	0.89

Conclusions:

As an alternative tool to the traditional gait analysis system based on high-speed cameras and stationary force plates, our sensor system can obtain 3D motion and force data on successive gait in various walking environments. The preliminary experimental validations show that the ankle joint and knee joint moments were estimated with a good accuracy, and the hip joint moments were measured with less accuracy using the developed sensor system.

Challenges and future requirements:

Since only straight level walking was tested using the wearable sensor system, in the future it is necessary to examine more movements to validating the ambulatory measurements of the system. Moreover, a statistical analysis of the multi-dimensional GRF and 3D orientations data extracted from successive gait measurements will be used to quantitatively evaluate normal and pathological gaits. As for the wireless data transfer system, the sampling frequency should be increased to satisfy the applications of the human-robot interaction and exoskeleton robot control.

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Selected papers

[1] Tao Liu, Yoshio Inoue, Kyoko Shibata, Triaxial joint moment estimation using a wearable three-dimensional gait analysis system, Measurement, Vol.47, No.1, pp. 125-129, 2014.
[2] Yizhai Zhang, Jingang Yi, Tao Liu, Embedded Flexible Force Sensor for In-Situ Tire–Road Interaction Measurements, IEEE Sensors Journal, 13: 5. 1756 - 1765, 2013.
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[4] Tao Liu, Yoshio Inoue, Kyoko Shibata, Kouzou Shiojima, A Mobile Force Plate and Three-dimensional Motion Analysis System for Three-dimensional Gait Assessment, IEEE Sensors Journal, 15: 5. 1461 – 1467, 2012.
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[11] Tao Liu, Yoshio Inoue, Kyoko Shibata, Development of a Wearable Sensor System for Quantitative Gait Analysis, Measurement, Vol.42, No.7, pp. 978-988, 2009.

Investigations of AMC and Its Applications for Performance Enhancement and Polarization Rotation of Antenna Arrays

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Purpose:

Artificial magnetic conductor (AMC) structure is an effective approach to significantly improve the bandwidth and radiation gain of low-profile antennas. Three kinds AMCs including periodic square AMC, non-periodic stub-loaded AMC (SLAMC) and polarization rotation AMC (PRAMC) are proposed and applied in antennas, respectively. Using the periodic square AMC, the 2 × 2 edge-fed patch antenna array achieves over 4 times bandwidth enhancement and about 3 dB peak gain improvement than the cavity backed antenna, and the millimeter-wave (mmW) LTCC antenna array also shows an efficiency of 63.1%, which is higher than previously reported mmW LTCC antennas. Comparing with the periodic AMC, the non-periodic SLAMC with different lengths of stubs can further improve antenna radiation. The SLAMC-based patch antenna has wider relative bandwidth and a gain enhancement of 1.73 dB. In addition, the novel wideband and low-profile PRAMC is proposed and applied in a dipole antenna to achieve circular polarization radiation. Consequently, good right-handed circular polarization with a broad axial ratio bandwidth and a large axial ratio beamwidth are realized for the dipole antenna.

Methods:

Recently, due to the in-phase reflection characteristics, artificial magnetic conductor (AMC) structure has been proposed and employed as the antenna ground plane instead of the perfect electric conductor (PEC) for improving radiation performance of antenna elements. Compared with previously reported techniques, the AMC technique would introduce no extra processes and takes the merit of easy integration; moreover, a more low-profile size can be achieved in the antenna array using AMC plane.

In addition, circularly polarized (CP) waves can be generated by a linearly polarized antenna using a complex AMC. A rectangular AMC structure exhibits different in-phase reflection coefficients in different orientations. By properly combining the incident wave from the antenna and the reflected wave from the AMC structure, a single dipole rotated by 45° on the AMC structure can operate like a meander-line polarizer which can change the linear polarization to circular polarization. Similarly, a truncated square patch antenna with a rectangular AMC structure can achieve circular polarization in a wide band.

Conclusions:

Three kinds AMC structures and their applications have been presented. Enhanced gains and bandwidths have been achieved in the antennas using the periodic AMC or the non-periodic SLAMC. In addition, a good RHCP radiation has been realized in a linearly polarized dipole antenna using the PRAMC.

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1990 B. Sc. Candidate, East China Institute of Science & Technology
Major: Radio Technology

Professional memberships

IEEE Senior Member

Selected papers

[1] W. C. Yang, H. W, W. Q. Che and J. J. Wang, "A wideband and high-gain edge-fed patch antenna and array using artificial magnetic conductor structures," *IEEE Antennas Wireless Propag. Lett.*, vol. 12, pp. 769-772, Dec. 2013.

[2] W. C. Yang, H. W, W. Q. Che, Y. Huang and J. Wang, "High-gain and low-loss millimeter-wave LTCC antenna array using artificial magnetic conductor structure," *IEEE Trans. Antennas Propag.*, accepted, Oct. 2014.

[3] W. C. Yang, W. Q. Che and H. W, "High-gain design of a patch antenna using stub-loaded artificial magnetic conductor," *IEEE Antennas Wireless Propag. Lett.*, vol. 12, pp. 1172-1175, Dec. 2013.

[4] W. C. Yang, K.-W. Tam, W.-W. Choi, W. Q. Che and H. T. Hui, "Novel polarization rotation technique based on an artificial magnetic conductor and its application in a low-profile circular polarization antenna," *IEEE Trans. Antennas Propag.*, accepted, Oct. 2014.

Priors based Medical Image Segmentation

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Purpose:
Medical image segmentation is important to computer assistant diagnosis. However, due to the low contrast and noises of medical images, it is challenging to accurately segment the organ of interest, which largely affects the judgment of doctor on disease situation, and hence impacts the diagnosis decision and the treatment planning. Priors, as a high-level knowledge, can compensate for the limitation of the low-level image appearance and help to achieve accurate segmentation results. We try to integrate the priors into the organ segmentation to achieve accurate medical image segmentation.

Methods:
To accurately segment the organ of interest, **firstly**, we explicitly establish a manual model for the priors of vessels and incorporate it into the energy function of level set for the vessel segmentation of liver and lung. **Then** we implicitly learn the shape priors from training images and integrate it into the automatic liver segmentation under auto-context model. With the multi-atlases strategy, we fuse the classification results from each atlas space to achieve the final liver segmentation from 3D CT images. **Finally**, we explicitly learn a shape prior model, by sparse learning, to guide the deformation of organ shape in lung field segmentation. Together with the appearance model, which is learned also by sparse learning, we accurately delineate the lung field by deformable model from 2D chest radiograph.

Results:
The priors modeling strategies have been comprehensively evaluated on different datasets. The manual model is used to extract the liver and lung vessel tree as well as the coronary artery from high-resolution 3D CT images. The experiments show that our model is more accurate and robust, compared with several classical active contour models and manual extraction. The implicit model is evaluated on the datasets of MICCAI 2007 liver segmentation challenge. The experimental results show that the average volume overlap error and the average surface distance achieved by our method are comparable to the results of the state-of-the-art. The explicit model is validated on a public lung field dataset. The experimental results show that the proposed shape prior model outperforms the conventional shape model. Also our method shows a higher accuracy, which is comparable to the inter-observer annotation variation.

Conclusions:
The authors have investigated several prior models for medical image segmentation, which can facilitate accurate organ segmentation.

Challenges and future requirements:

Priors are useful for medical image segmentation. However, the priors of some organs are complicated, and difficult to accurately model. We will try learning an accurate prior model for such organ in the future.

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Education & Training

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Selected papers

[1] Yeqin Shao, Yaozong Gao, Yanrong Guo, Yonghong Shi, **Xin Yang**, and Dinggang Shen., "Hierarchical Lung Field Segm entation With Joint Shape and Appearance Sparse Learning", IEEE Transactions on Medical Imaging. 2014,33(9):1761-1780.
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Internet of Things for Smart Aging

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Purpose:
Faced with the aging problem, internet of things (IoT) based smart aging solutions are urgently needed for healthcare for the old people. This talk will summarize the state-of-the-art, challenges and opportunities in smart aging, and introduce our recent related reseach and development work. A number of key issues and results will be reported, including the system architecture for mobile healthcare, wearable sensing platform, context-aware ECG signal processing, motion tracking and activity recognition, abnormality detection and alarming, wireless localization, mobile Internet for service access etc.

Methods:
The developed system architecture for mobile healthcare is shown in Fig. 1, targeted on the health monitoring and sevice providing any time any where. Raw medical and motion signals are collected by wearable sensors to the mobile gateway (usually using mobile phone), forwarded to the cloud server via wireless networks, then the family members, community service providers, and medical service providers can access the data and service from the clound platform via mobile Internet. The architecture enables various services such as energency response, health query, and remote medical care. A number of key technological approaches such as wavelet based ECG signal processing, context-aware abnormality detection, extreme learning machine (ELM) based activity recognition, WiFi based wireless localization etc. are also developed.

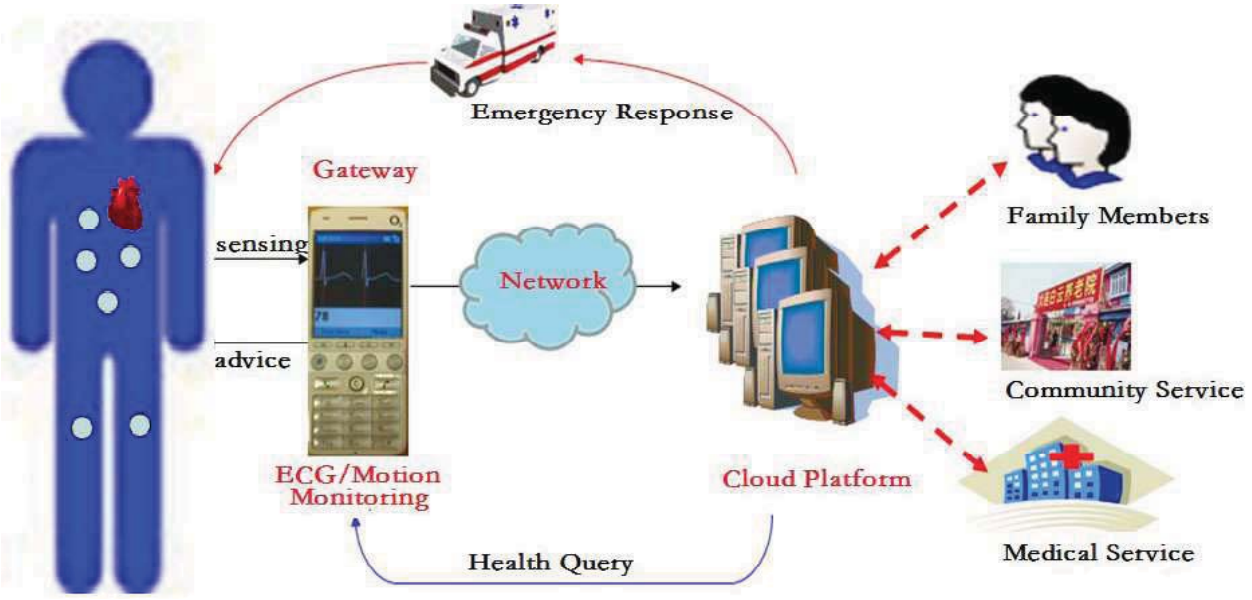

Fig. 1 System Architecture for Mobile Healthcare

Results:

The developed prototype system is illuminated in Fig. 2 and works well. Experimental results also shown that the developed technologies, including wavelet based ECG signal processing, context-aware abnormality detection, extreme learning machine (ELM) based activity recognition, as well as WiFi based wireless localization, can achieve good performance.

The system has been implemented in a number of elder care centres with satisfactory operational experience.

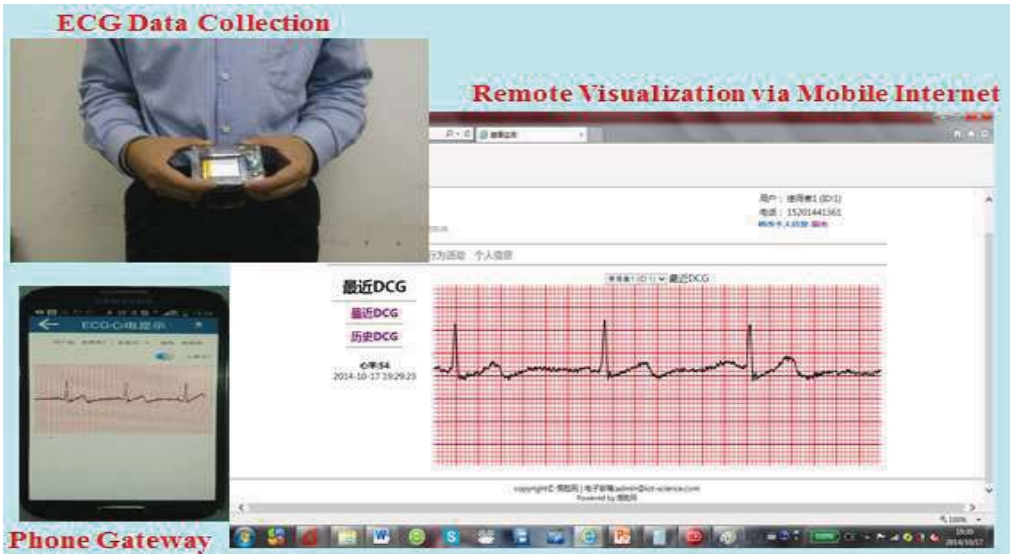

Fig. 1 Developed Prototype System

Conclusions:

Our recent developed IoT solution for smart aging is introduced, together with a number of key design issues and results, including the system architecture for mobile healthcare, wearable sensing platform, context-aware ECG signal processing, motion tracking and activity recognition, abnormality detection and alarming, wireless localization, mobile Internet for service access etc. The developed system and experimental results are also briefly reported.

Challenges and future requirements:

A number of issues shall be addresed as the future work, including development of low-cost compact wearable devices suitable for the elder, big data processing for understanding the monitoring data and decision making, system integration and information exchanging methodology among variour healthcare players, standardlization of the health data and information, etc.

Biographic sketch

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Education & Training

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Professional memberships

2009 Senior Member of IEEE

Selected papers

[1] **W Xiao**, and Y Lu, Daily Human Physical Activity Recognition based on Kernel Discriminant Analysis and Extreme Learning Machine, Mathematical Problems in Engineering, in Press.
[2] S Zhang, **W Xiao**, J Gong, and Y Yin, A Novel Human Motion Tracking Approach based on a Wireless Sensor Network, International Journal of Distributed Sensor Networks, 2013, Article ID 636052, pp.1-7.
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The Development of a Portable and Non-invasive

Swallowing Assessment Approach

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Purpose:

When the food is hard to be swallowed inside the mouth through the esophagus to the stomach, we call this symptom the dysphagia. Many acute and chronic illnesses will cause the dysphagia, such as cleft lip and palate born child, cerebral palsy and stroke, etc. It is showed that in an acute medical institude, there are about 12% of patients with dysphagia, while in a long-term health-care organization, the proportion of the patients who have swallowing difficulty may be more than 50%. If the symptom of the oropharyngeal dysphagia has not been properly treated, it will lead to many complications. The most important one is that the eating behavior of the patients will be affected which leads to dehydration, malnutrition, choking injuries, aspiration pneumonia and even death. Therefore, early assessment to change the way of eating can prevent them from having the oropharyngeal dysphagia at a high risk; it can also help the patients to have a safe way in diet to maintain sufficient nutrition and avoid leading to other complications.

Most conventional assessments for measuring the oropharyngeal dysphagia symptoms are invasive approaches. The most widely used invasive equipment is "Video Fluoroscopic Swallowing Study (VFSS)", which is an X-ray photography equipment. In many medical organizations, it will be considered as the examination standard. However, it will bring the risk of radiation exposure. Another invasive assessment is to use the fiberoptic endoscopic to evaluate the oropharyngeal dysphagia. A subject will be asked to eat the food or liquid, which was colored in blue or green. Then the physician will use the micro-camera (endoscope) with optical fibers to observe the action of nasopharynx in the mouth and throat. This approach can help the physician to observe the reflected swallowing flow in the residual state of oropharynx and hypopharynx before and after the subject eating the food. However, it needs the endoscope to be placed into the mouth and throat during the test. A subject will feel uncomfortable and difficult to swallow the food.

Methods:

The goal of our research is to design a portable and non-invasive monitoring system for the oropharyngeal dysphagia. We use the FSR (Force Sensing Resistor) sensor to develop such a system which can be applied to bedside assessment or homecare applications. The system consists of a FSR throat belt, a holter and a monitoring system. The FSR throat belt is made by soft and flexible materials with a FSR sensor embedded in the middle of the belt. The signals measured by the FSR will be collected into the holter. The holter performs basic signal preprocessing. The data after preprocessing can be displayed immediately on the smart phone or be sent to the remote system afterwards.

Results and Conclusions

We find that the FSR-based throat belt can effectively measure and differentiate the swallowing parameters between different age groups by swallowing different volumes of water. We also find that the differences exist between the male and the female subjects, and the deterioration of the swallowing ability will occur along the increases of the ages. Through

our testing, we also show that the volume of 20 ml water would be a swallowing limitation for some elder subjects. This fact is very important and useful in developing practical healthcare applications, e.g., bedside diagnosis, for dysphagia patients.

Challenges and future requirements:

Through the clinical trials, we find that the tongue pressure could be another important factor affecting the swallowing ability. So far there are only a few studies addressed about the measurement of the tongue pressure. A non-invasive, comfortable but also accurate approach would be needed.

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Selected papers

1. Wann-Yun Shieh, Hsin-Hung Cho, "Smart Belt-Using Dual Accelerometers for Gait Analysis," Journal of Medical Imaging and Health Informatics, Vol. 3, 65-71, 2013
2. Wann-Yun Shieh, Ju-Chin Huang, "Falling-incident Detection and Throughput Enhancement in a Multi-camera Video-surveillance System," Medical Engineering and Physics, Vol. 34, 2012, pp. 954-963
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Computer assisted surgery: planning, simulation, template guiding, and navigation

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Purpose:

During the past decades, tremendous progress has been made in the computer-assisted systems in surgery and development for medical image analysis, surgery simulation, surgical robots, etc. The aims of computer-assisted surgery are to improve patient care by advancing the utilization of computers during treatment; and to evaluate the benefits and risks associated with the integration of advanced digital technologies into surgical practice. With the collaboration of some prestigious hospitals, our research team has embarked on the research of computer assisted surgery for more than a decade, aiming at reducing the risk and improving the precision of the complex surgery.

Methods:

With the use of a self-developed preoperative planning software, a detailed treatment plan including osteotomy trajectory determination, reposition of the splitted bones, optimization of the position and orientation of implants, etc., can be conducted on the basis of the CT-scanned data of the patient. Then, the resulting data of the preoperative planning can be transferred to a self-developed virtual simulation and training system using a haptic feedback device (Omega 6) and immersive workbench (Display 300). The surgeon can then "perform surgery" upon the 3D virtual tissues by manipulating the virtual handpiece, while the Omega.6 simultaneously provides realistic force-feedback and collision detection during the osteotomy procedure. Based on this simulation system, the surgeon can get familiar with the preoperative plan and experience the specific operations when being surrounded in an engrossing total virtual environment. To provide a link between the preoperative plan and the actual surgery, a novel surgical template design and manufacturing method was developed, utilizing laser scanning, image registration, and rapid prototyping technology. This treatment plan can also be transferred to a self-developed intra-operative navigation system, or even a surgical robot. During the surgery, with the support of the optical tracking device, point-based or surface-based registration is performed to determine the spatial relationship between Virtual Coordinate System(VCS) and Real Coordinate Space (RCS). After registration, there will be constant visualization of the surgical instrument trajectory on the computer screen, so that the osteotomy procedure can be performed by a surgeon or robot according to the original plan under the guidance of 2D/3D interactive image rendering environment.

Results:

With the aid of this system, the precision achieved in the planning phase can be transferred to the operating theatre so that the feasibility and reliability of the surgery can be achieved in anatomically complex operation sites. Clinical applications have been successfully conducted, demonstrating the feasibility, reliability and validity of this technology.

Conclusions:

This study presents a comprehensive computer-aided surgical system, which integrates preoperative planning, surgery simulation, template guiding, and intraoperative navigation into a whole. This system has been successfully used for a number of clinical cases, demonstrating its reliability and validity.

Challenges and future requirements:

More complicated issues such as real-time simulation, tracking and visualization of the soft tissue will be studied in the future.

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Education & Training

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Professional memberships

2013 Scientific board member, CAI(the International Academy of Computer Aided Implantology) academy
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2012 Editorial board member, *Journal of Contemporary Medical Education*
2013 Editorial board member, *Edorium Journal of Biomedical Science*
2014 Editorial board member, *The Journal of Dentist*
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Selected papers

[1] **Xiaojun Chen**, Jianbing Yuan, Chengtao Wang, Yuanliang Huang, Lu Kang. Modular preoperative planning software for computer-aided oral implantology and the application of a novel stereolithographic template: a pilot study. Clinical Implant Dentistry and Related Research. 2010; 12(3):181-193

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A Cable-driven Soft Robot for Minimally Invasive Surgery

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Purpose:

Recently, with the deterioration of environment and the fast pace of modern life, the disease's threat is growing and medical resources are getting more strained than ever. Against this background, there is increasing demand for minimally invasive surgery. Although endoscopic systems are used widely, the existing tools are difficult to handle dexterously in beating-heart environment. The SJTU Autonomous Robot Laboratory is developed a new cable-driven soft robot to perform cardiac biopsy and ablation on beating heart.

Methods:

The soft robot is mainly composed of two parts: the endoscopic probe and the feeding station. The probe, made of soft silicone material, is non-toxic, and will not injure human body's tissues. The feeder inserts the probe into patient's body and produces torsion through a small incision. Medical tools and a micro medical camera are loaded inside the probe. To study the feasible of the system, some experiments with a swine have been performed. Large(40kg) healthy swine was anesthetized and placed into supine position. A 50mm skin incision was made at the subxiphoid. Then, the pericardium was incised in 20mm length. The soft robot inserted into the pericardial space through the hole. Different position was selected as the targets to reach by the soft robot to perform the cardiac ablation. The blood pressure and other physiological features were monitored continuously and the test was observed and recorded using a thoracoscope.

Results:

The probe was controlled to insert into the beating heart and move to the different parts of the heart. The results are satisfactory and the probe can reach to the target positions. The swine was survived until euthanasia at the end of all the experiments. The ability of the soft robot turns out to be outstanding in crowded environment.

Conclusions:

The experiments with the swine show that the cable-driven soft robot is suitable for cardiac surgery. The size of the probe is ideal and the system can be controlled flexibly.

Challenges and future requirements:

More swine experiments will be performed to evaluate the system deeply and the biopsy will be performed to test the feasible of the tip of the probe.

As the shape of the probe cannot be sense from the outside, some sensors will be added to the probe to sense the shape of the probe.

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Application of 3D Printing Technology in Orthopedic Surgery

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Purpose:

U.S. TIME magazine listed 3D printing technology into "America's top ten fastest-growing industries", and British The Economist magazine believes that 3D printing technology will "promote the realization of the third industrial revolution together with other digital production modes". This presentation will review our research work in the development of individualized prosthesis and tissue engineering scaffolds through 3D printing technique for individualized treatment.

Methods:

1) Based on the 3D printing technology, the design and manufacturing platform of customized medical implants was set up, whose products have been applied in the orthopedic surgery for surgical guides, individually printed metal prosthesis and individualized template for surgical resection. 2) Applied with 3D printing technology, a biphasic scaffold, which consisted of polylactic acid-coated polyglycolic acid (PGA/PLA) scaffold and poly-epsilon-caprolactone /hydroxyapatite (PCL/HA) scaffold, was designed and used for regeneration of goat femoral head with desired shape and structure.

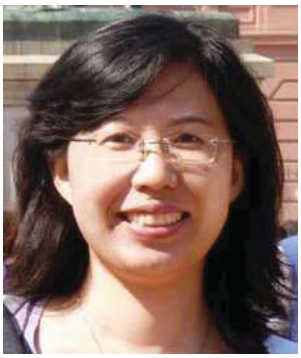
Results:

1) The developed individualized prostheses based on the 3D printing technology have achieved industrialization and been approved with registration certificates in Medical Device Manufacturing by FDA of China. 2) The regenerated femoral heads presented a precise appearance in shape and size similar to that of native goat femoral heads with a smooth, continuous, avascular and homogeneous cartilage layer on the surface and stiff bone-like tissue in the microchannels of PCL/HA scaffold, showing that the 3D printing technology provides a promising approach for regenerating a biological joint which could be used to reconstruct the impaired joint.

Challenges and future requirements:

There are many potential patient-specific applications of 3D printing technology in medicine. However, the technique needs to be optimized and more knowledge is required regarding the development of printed living constructs into functional tissues which can be clinically applied.

Biographic sketch



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Education & Training

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Professional memberships

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Selected papers

[1] Yu Wu，Yinzhi Wang, Fei Xiao , Dongyun Gu*. Kinematic Characteristics of gait in Middle-Aged Adults. Conf Proc IEEE Eng Med Bio Soc 2014

[2] Xiao Fei, Zanjing Zha, Xuqiang Liu, Chuan Jiang, Dongyun Gu*. Geraniin suppresses RANKL-induced osteoclastogenesis in vitro and ameliorates wear particle-induced osteolysis in mouse model. Experimental Cell Research, 2014, In press.

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Image registration for analysis of the interrelation between pathological image and MR image of brain tumor

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Purpose:

Because infiltrated regions with tumor are often indistinct on the MR image, it is difficult to identify tumor regions exactly. For revealing the relationship between tissue information and MR signal of the tumor, pathological images and MR images have to be analyzed on the same regions. However, we cannot make sure that where is corresponding between pathological images and MR images because pathological images are parted and deformed through tissue specimen making. We propose bi-gradient registration method using parted pathological images, 3D MRI and a macro image that is captured by an optical camera.

Methods:

Figure 1 shows an outline of proposed method. Parted pathological images are pieced together with macro image. All pathological images at the same slice are aligned by referring to the macro image and connected by use of corresponding feature points. Then, 3D MR image is precisely registered to connected pathological image by a non-rigid registration.

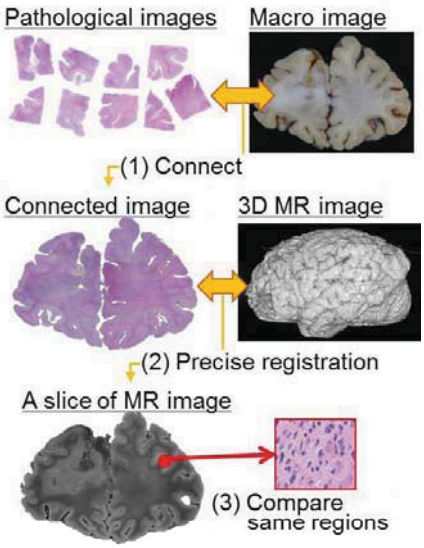

Fig. 1 Outline of proposed method

Results:

Proposed method was applied for a dataset taken from a patient of Glioblastoma that is one of the brain tumor. Figure 2 shows the result of each step. Connected pathological image was obtained from several ones successfully. MR image was deformed correctly.

Conclusions:

We developed the bi-gradient registration method using parted pathological images, 3D MR image and macro image. Through experiment, we obtained similar image to pathological image from 3D MR image.

Challenges and future requirements:

Initial parameters and feature points have to be set for each parted pathological image in the first step. Auto determination algorithms are required. We will analyze the relation between tissue information and MR signals.

Presentation type: Oral Presentation

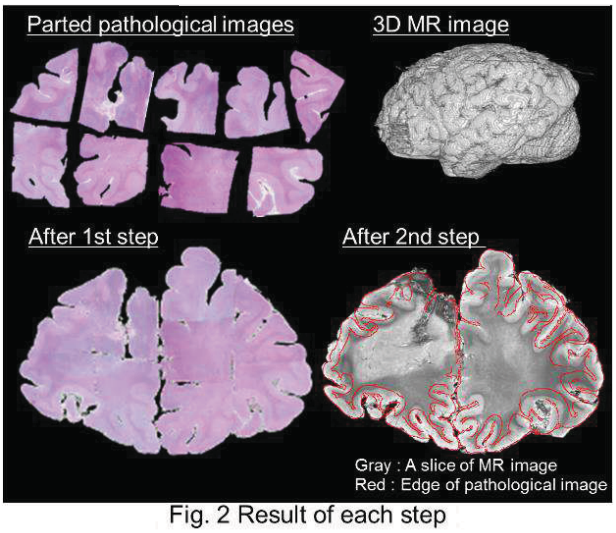

Fig. 2 Result of each step

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Selected papers

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Developing At-home Assistive and Rehabilitative Systems

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Purpose:
Recently, there are rising needs of rehabilitation and function assistance for older and disabled persons living at home. In our group, we aim at developing adaptive interface and seamless bio-monitoring solution for the at-home assistive and rehabilitative systems. Adaptive interface could enable a device to change its control output according to the property of its controlled object. For assistive and rehabilitative technology, this could decrease the burden of medical or paramedical staffs, by dealing with the time varying and individual dependent characteristics of human motor function. This would be especially important for the function restoration of the motor function-impaired people living at home, who should do most training with their own effort. To deal with the safety issue, focus was put on how to realize cost-effective and seamless bio-monitoring with less physical constraints to subjects

Methods:
Our research efforts include 1) An individual adaptive interface for assistive and rehabilitative devices; and 2) A bio-monitoring robotic system for home health care, which could track, measure the subjects and analyze their behavior of subjects in home environment.

Results:
A mutual adaptation method was developed to adapt the interface that could support the motion detection for the forearm, shoulder amputees for their finger, hand, lower and upper arm motions. Moreover, experiment results showed that an audio and visual display based sensory feedback could not only improve the performance of the reaching-grasping activity, but also decrease the mental load of users. On the other hand, the bio-monitoring robots could acquire not only the motion data but also part of physiological information of subjects while tracking them.

Conclusions:
This research could provide effective solutions for at-home assistive and rehabilitative systems, to help the older and disabled persons restore their function in their own living environment. We have still a long way to go before our ultimate goal could be realized.

Challenges and future requirements:
Further research efforts should be focused on, 1) portable and packable assistive and rehabilitative devices under the constraints of weight and shape; 2) sensory feedback optimized for individual patients taking into consideration the mental load, and performance in ADL; 3) long-term experiment for testing the at-home bio-monitoring robot.

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Selected papers

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A Computer-aided Analysis System of Liver Structures with CT

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Purpose:

Liver cancer is a disease with high mortality rates in China. Nowadays, the surgical operation to remove the damaged parts of liver is an important and often best therapeutic option. The effects of liver surgical operations significantly depend on surgeons who need correct structural information of tumors and accurate positional relationships between these tumors and liver blood vessels. Therefore, the accurate location and segmentation of liver structures, lesions and liver vessels are of key importance for correct liver surgical planning. In CT data, however, the intensity of adjacent organs is very similar to liver and pathologies inside liver like large tumors, cirrhosis, or partial liver resection with remaining scars. Besides, the intensity gradient of blood vessels is heavily influenced by noise. Both cases challenge the accurate segmentation of liver structures with automatic segmentation approaches. Therefore, the appropriate interactive segmentation methods need to be developed for fast and accurate extraction of various liver structures and liver vessels.

Methods:

1. An interactive segmentation method is applied to extract liver from 3D CT data.
2. An interactive platform is developed for the surgeons to amend the segmentation results.
3. A method based on CUDA is used for fast extraction of liver vessels.

Results:

1. Liver segmentation: the liver structures can be extracted by interactive and fast method (<5s for each slices), and amended by surgeons with interactive platform.
2. Vessel detection: the whole structure of liver vessel is extracted using GPU. It eliminates the problem of 'Out of Memory' and reduces the computational time significantly (33.49s (GPU) vs 1375.56s (CPU)).

Conclusions:

1. An improved approach for livers segmentation is applied, which can provide more credible results for liver structure segmentation.
2. An interactive platform is developed to facilitate surgeons revising the liver segmentation results slice by slice.
3. A fast vessel segmentation method is applied, which can discards falsely enhanced tissues and reduces computational time significantly.

Challenges and future requirements:

1. Liver segmentation: developing segmentation methods robust against weak contrast between liver and other tissues; designing segmentation algorithm for 3D CT data.
2. Vessel detection: developing vessel extraction methods robust against the noisy gradient intensity values of blood vessels; designing fast methods based on GPU.

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Selected papers

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Effective Microwave Heating for Bile Duct Carcinoma under Metallic Stent Placement

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Purpose:
Microwave thermal therapy is one of the modalities for cancer treatment. Here, there are several schemes of microwave heating. The authors have been studying thin coaxial antenna for intracavitary microwave heating aiming at the treatment of bile duct carcinoma. In this treatment, an endoscope is first inserted into the duodenum and a long and flexible thin antenna is then inserted into the forceps channel of the endoscope, which is used to insert the tool for surgical treatment. Finally, the antenna is guided to the bile duct through the papilla of Vater, which is located in the duodenum, and is inserted into the bile duct. Up to now, the heating characteristics of the antenna are investigated by numerical simulation and experiment for finding a possibility of the treatment. By the way, placement of self-expandable metallic biliary stents is the standard treatment for patients suffering from bile duct obstruction. Even so, restenosis of the bile duct caused by growth of cancer cell has become a serious problem. In such a case, the microwave thermal therapy may effective. However, our previous study shows that it is difficult to obtain effective heating region along the metallic biliary stent, because of the electromagnetic wave shielding effect. Therefore, in this study, effective heating techniques under the stent placement are considered.

Methods:
In order to realize the effective heating around the metallic biliary stent, structure of the stent and microwave antenna for feeding are investigated. These analyses are performed by use of finite-difference time-domain (FDTD) calculations. Moreover, heating patterns around the metallic biliary stent are observed by thermographic method, which are employed a biological tissue-equivalent solid phantom and an infrared camera.

Results:
According to results of the numerical calculations, possibilities of the heating around the metallic biliary stent could be observed by use of our developed metallic stent and newly developed feeding antenna. Moreover, validity of the calculated results could be confirmed by the phantom experiments.

Conclusions:
As the results of investigations, possibilities of the microwave heating for bile duct carcinoma could be confirmed under the stent placement.

Challenges and future requirements:
As a further study, results of the investigations should be confirmed by animal experiments.

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Development of Computer-Aided Diagnosis System to Detect Lesions for Voiding Dysfunction using Cystourethroscopy

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Purpose:

Lower urinary tract consists of hollow and tubular organs, which is closing in the continent condition and deformed under internal pressure during micturition. Among various methods, cystourethroscopy constantly provides shape and color information of the urethra together with a role as a potent therapeutic tool. We developed software to generate a panoramic image from cystourethroscopic video image and construct a three-dimensional (3D) model of the intra-urethral information for a Computer-Aided Diagnosis (CAD) system to determine candidate lesions for voiding dysfunction, and tested its validity.

Methods:

Cystourethroscopy was performed in nineteen patients with benign prostate hyperplasia around administration of alpha-1 adrenoceptor blockade under approval of local ethic committee. Cystourethroscopic video image was recorded from bladder outlet to the distal part of the verumontanum by slowly withdrawing the scope in about 10 seconds. An opened panoramic image was processed by retrieving and connecting color information on each video frame. At the same time, the reflection intensity of each pixel was measured to estimate the shape of the urethral wall. Using the information, a virtual 3D model of urethra was generated under an assumption that the urethra is a cylindrical organ. The software was designed to call back the video frame by putting a pointer on the panoramic image to identify the region of interest. In addition, fluid dynamics through the 3D model was computed to simulate the urine flow in the prostatic urethra.

Results:

3D image processing was successfully achieved in 17 of 19 patients. In the urine stream simulation, turbulence and vortex formation was observed adjacent to obstacles in 3D model in the 17 patients before therapy, and was diminished after therapy in 9 patients who showed improvement of urine flow. The obstacles can be identified in the panoramic image, and then indicate the “candidate lesion” for voiding dysfunction in the original cystourethroscopic video image.

Conclusions:

Processing 3D endoscopic image of the male urethra, linked to the original cystourethroscopic video image would contribute to establish novel therapeutic modality to minimize its drawbacks in patients with voiding dysfunction.

Challenges and future requirements:

Development of a surgical simulation system for trans-urethral resection of prostate which indicates optimal lesion and amount of resection to achieve maximum effect of the therapy without complications.

This manuscript was formerly presented in the 34th Congress of the Société Internatinale d’Urologie, held in Glasgow, UK on October 12-15, 2014.

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Selected papers

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Novel Microstrip Bandpass Filter with Multiple Transmission Zeros Using Open/Shorted Stubs

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Purpose:

A novel microstrip bandpass filter with multiple transmission zeros using open/shorted stubs is presented in this paper. By utilizing shorted coupled lines and the open/shorted stubs, eight out-of-band transmission zeros can be realized for the bandpass filter from 0 to $2f_0$ (f_0 is the center frequency of the passband). The eight transmission zeros can be adjusted freely by only changing the electrical length of the open/shorted stubs. A planar bandpass filter (3-dB fractional bandwidth 7.5%, 3.85-4.15 GHz) is designed and fabricated. The theoretical and measured results all show good in-band filtering performances and high selectivity.

Methods:

As one of the most commonly used filters, microstrip filters are easy to be integrated into passive or active microwave circuits due to the features of planar structure, easy fabrication and low cost etc.. With the increase of the numbers of the out-of-band transmission zeros, the rejection levels and harmonic suppression of the bandpass filters can be further improved due to the suppression of the unwanted periodic harmonics.

To realize multiple out-of-band transmission zeros, cross coupling between non-adjacent resonators is introduced to obtain an elliptic function . However, four and more resonators are usually needed with disadvantages of large circuit size and serious insertion loss for this method. Discriminating coupling, which blocks unwanted signals at certain frequency and allows the transmission of signals at other frequencies, can be used to suppress the harmonics with additional transmission zeros. Moreover, dual-behavior resonators (DBRs) with two stopband structures which introduce two transmission zeros of the passband can be used to design high performance narrow-band bandpass filters. Transversal signal-interaction concepts have also drawn a lot of attention during the past several years. By introducing intentionally a passband constructive interference and out-of-band signal energy cancellations to produce power transmission zeros, high-selectivity filtering responses and harmonic suppression can be achieved in this kind of filter structures.

In this paper, a novel bandpass filters with multiple transmission zeros using only four open/shorted stubs is proposed. Eight transmission zeros without complex coupling structures can be introduced to suppress spurious resonances of the both sides of the bandpass response. The out-of-band transmission zeros can be adjusted easily by only changing the electrical length of the four open/shorted stubs. A prototype of the bandpass filter operating at 4.0 GHz is constructed on the dielectric substrate with $\varepsilon_r = 2.65$, $h = 0.5$ mm, and $\tan\delta = 0.003$. The proposed designs are very simple and have good in-band and out-of-band performance.

Conclusions:

In this work, a high selectivity bandpass filter with eight transmission zeros using only four open/shorted stubs are proposed. The out-of-band transmission zeros can be adjusted easily by only changing the electrical length of the open/shorted stubs when the ratio of

characteristic impedance of the stubs is fixed. The proposed bandpass filter has advantages of compact effective circuit size and simple design theory, which will make the proposed filter suitable for wireless applications.

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Selected papers

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Water-Filled Laparo-Endoscopic Surgery (WaFLES): Update

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Purpose:
In the previous sessions of IS-3T-in-3A, we introduced system of WaFLES that carried out surgery “under water”. Replacement of mass of irrigant requires at least a few centimeter sized channel in the abdominal wall. Thus single port surgery is rational for this purpose. Since the WaFLES system is approaching to clinical use, efficacy in continuing surgery and adverse effects by loading much irrigant were estimated.

Methods:
Between December 2012 and February 2014, we compared physiological condition of conventional laparoscopic surgery and WaFLES in 12 SPF pigs under approval of local ethics committee for animal experiments. In WaFLES, abdominal cavity was irrigated using saline via a cistern set on the small incision and was drained via a suction tube set in the bottom of the abdominal cavity. Pigs were set in the spine position under general anesthesia operated with positive expiratory end pressure set at 5 cmH2O, and excision of kidney, liver, diaphragm, and resection of the urinary bladder was attempted.

Results:
In WaFLES, no harmful effects were noted including lung or brain edema. Body temperature, blood PO2, serum electrolytes were comparable to conventional laparoscopic surgery. Prevention of hypercapnia or acidosis was observed in WaFLES. However, increase of body weight was revealed in WaFLES. All the surgical maneuver including hemostasis was successful.

Conclusions:
WaFLES could be carried out without any serious adverse effects. Devices should be designed to match for clinical practice in the next step.

Challenges and future requirements:
Disadvantage of WaFLES is a narrow view field by interruption of floating organs. Adequate “frame” would be mandatory to secure view field at any conditions.

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Selected papers

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An Electrical Cylinder Driven Exo-Skeleton Robot

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Purpose:

In US and Japan, Exo-Skeleton robot has been proven a successful assistance device for healthcare of old people and health recovery of injuries. This project aims in developing an exo-skeleton robot for walking assistance and health recovery.

Fig. 1. Rewalk and HAL

Methods:
To successfully develop the exo-skeleton robot, we have adopted a number of key technologies, including the human-like lightweight robot structure design, the coordinated synchronous control of multiple servo motors integrating EtherCAT bus, multisensory human walking and stopping intention detection, etc.

Results:
Till now, we have designed and implemented two generation exo-skeleton prototypes. Regarding mechanical design issues, we have realized the human-like structure design and lightweight design; Regarding the robot control issues, we have realized the coordinated synchronous control of 6 servo motors through EtherCAT high speed bus; Regarding the human locomotion purpose recognition, we are working on the pressure based multisensory fusion and pattern perception.

Fig. 2. The two generation exo-skeleton robots

Conclusions:

By forming a multidisciplinary research team, we formulated the multi-modal human motion model, designed and manufactured a lightweight exoskeleton robot, constructed a multisensory pressure and angle channel for human intention detection, and implemented a fast-following servo control method for human-like motion realization.

Challenges and future requirements:

Two major challenges remain in the current project. Firstly, we have to resolve the synchronous control problem of electrical cylinders to realize human-like fast walking and running patterns; Secondly, we have to resolve the human locomotion purpose recognition problem using pressure and/or EMG signals.

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Selected papers

[1] Jian Chen, Dong Sun, Jie Yang, and Haoyao Chen, "A Leader-Follower Formation Control of Multiple Nonholonomic Mobile Robots Incorporating Receding-Horizon Scheme," *International Journal of Robotics Research*, vol. 29, no. 6, pp. 727-747, 2010.

[2] Haoyao Chen, Dong Sun, Jie Yang, and Jian Chen, "SLAM Based Global Localization for Multi-robot Formations in Indoor Environment," *IEEE/ASME Transactions on Mechatronics*, vol. 15, no. 4, pp. 561-574, 2010.

[3] Jian Chen and Dong Sun, "Resource Constrained Multirobot Task Allocation Based on Leader-Follower Coalition Methodology," *International Journal of Robotics Research*, vol. 30, no. 12, pp. 1423-1434, 2011.

[4] Jian Chen and Dong Sun, "A Coalition Based Approach to Task Allocation of Multiple Robots with Resource Constraint," *IEEE Transactions on Automation Science and Engineering*, vol. 9, no. 3, pp. 516-528, 2012.

[5] Xiao Yan, Jian Chen, and Dong Sun, “Multilevel Based Topology Design and Shape Control of Robot Swarms,” *Automatica*, vol. 48, no. 12, pp. 3122-3127, 2012.

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[12] Jian Chen and Dong Sun, “An Online Coalition Based Approach for Solving Resource Constrained Multirobot Task Allocation Problem,” in *Proc. IEEE Int. Conf. Robot. Biomim.* (ROBIO), pp. 92-97, 2010.

[13] Haoyao Chen, Jian Chen, and Dong Sun “A Novel Allocation-Based Formation Algorithm for Swarm of Micro-Scaled Particles,” in *Proc. IEEE Int. Conf. Robot. Autom.* (ICRA), pp. 1664-1669, 2011.

[14] Xiao Yan, Jian Chen, and Dong Sun, “Multilevel Based Topology Design and Formation Control of Robot Swarms,” in *Proc. IEEE Int. Conf. Robot. Biomim.* (ROBIO), pp. 174-179, 2011.

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[16] Jian Chen, Eugen Richter, and Jianwei Zhang, “Bio-inspired Caterpillar-Like Climbing Robot,” in *Proc. 2nd Int. Conf. Biomimetic and Biohybrid Syst.* (Living Machines), pp. 359-361, 2013.

[17] Jian Chen, Jinghua Wu, Minzhou Luo, and Jianwei Zhang, “A Knitro-Based Realtime Locomotion Method for Imitating the Caterpillar-Like Climbing Strategy,” in *Proc. IEEE Int. Conf. Contr. Autom.* (ICCA), 2014.

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[19] Jian Fang, Tao Mei, Jian Chen, and Jianghai Zhao, "An iteration method for inverse kinematics of redundancy robot", in *Proc. IEEE Int. Conf. Mech. Autom.* (ICMA), 2014.

[20] Jian Fang, Jian Chen, Tao Mei, and Jianghai Zhao, "Multi-Level Constraints of Redundant Manipulator Handled by Different Trajectory Tracking", *in Proc. IEEE Int. Conf. Robot. Biomimetics* (Robio), 2014.

[21] Dongsen Ye, Shaoming Sun, Jian Chen, and Minzhou Luo, "The Lightweight Design of the Humanoid Robot Frameworks Based on Evolutionary Structural Optimization", in *Proc. IEEE Int. Conf. Robot. Biomimetics* (Robio), 2014.

Patient Management--Future of Medical Device

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Purpose:
Introduction of The Medtronic CRDM Patient Management and The Medtronic CareLink® Network.

The Medtronic CareLink® Network is the nation's leading remote monitoring service, connecting cardiac device patients to their clinic from home or away. The clinician has 24/7 access – via a secure Internet website – to a wide range of trended reports offering information comparable to an in-office visit. These diagnostic reports can be exported to his hospital network or EHR for greater accessibility to the data and clinical documentation. In addition, the clinician can receive Medtronic CareAlert® Notifications which provide alerts to potential issues before they become problems.

Methods:
NA

Results:
NA

Conclusions:
NA

Challenges and future requirements:
Will discuss the challenges to penetrate a new technology into a high diverse and dynamic international market.

Biographic sketch

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Education & Training

2011 – Now **Covidien**
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1998 – 2011 **Medtronic,**
R&D, Marketing, Technical Service

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Computer aided design of Fluid Power transmission and Control System

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Soft actuators with biomedical applications

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In response to a stimulus, a soft material deforms, and the deformation provides a function. Such a material is called a soft active material (SAM). This seminar focuses on one class of soft active materials: dielectric elastomers. When a membrane of a dielectric elastomer is subject to a voltage through its thickness, the membrane reduces thickness and expands area, possibly straining over 100%. In last decade, people did extensive experimental and theoretical studies on dielectric elastomers, and found that dielectric elastomer actuators may exhibit the following attributes: large deformation, high energy density, fast response, etc. These attributes make dielectric elastomer actuators resemble natural muscles. Recently, the dielectric elastomers are being developed as transducers for broad applications, including stretchable ionic conductors, biomedical devices, soft robots, etc. In this seminar, I will mainly discuss the biomedical applications of dielectric elastomers, such as soft sensors, soft actuators for facial expression, haptic feedback, etc.

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Professional memberships

Member, ASME
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Member, MRS

Selected papers

[1] Kollosche, M., Kofod G., Suo, Z.G., and Zhu, J., Temporal evolution and instability in a viscoelastic dielectric elastomer. Journal of the Mechanics and Physics of Solids, Accepted.
[2] Godaba, H., Foo, C.C., Zhang, Z.Q., Khoo, B.C., and Zhu, J., Giant voltage-induced deformation of a dielectric elastomer under a constant pressure. Applied Physics Letters 105, 112901, 2014.
[3] Zhu, J., Kollosche, M., Lu, T., Kofod, G., and Suo, Z., Two types of transition to wrinkles in dielectric elastomers. Soft Matter 8, 8840-8846, 2012.
[4] Kollosche, M., Zhu, J., Suo, Z., and Kofod G., Complex interplay of nonlinear processes in dielectric elastomers, Physical Review E 85, 051801, 2012.
[5] Zhu, J., Cai, S., and Suo, Z., Resonant behavior of a membrane of a dielectric elastomer. International Journal of Solids and Structures 47, 3254-3262, 2010.

Poster

December 22, 2014 (Monday)

14:50~15:40

P1	Physics-based Optimization Design of Broadband Folded Dipole Antennas through Manipulations on Smith Chart Yumei Chang, Nanjing University of Science and Technology, China
P2	A Sematic Map Based Approach for Seamless Interaction between Mobile Service Robot and Human Users Zhixuan Wei, Shanghai Jiao Tong University, China
P3	Evaluation on Heating Performances of Microwave Scalpel for Surgical Operation Kenta Suzuki, Chiba University, Japan
P4	SAR Evaluation of 1.2 GHz Band Wireless Camera Using A Tissue-equivalent Solid Phantom Tetsuya Yoshida, Chiba University, Japan
P5	Dual-band Diversity Antenna for Mobile Phone Diversity Antenna Qing Luo, Southeast University, China
P6	A Multiple-Sucker Manipulator for Intra-Abdominal Underwater Surgery Support Nobuto Tsuchiya, Chiba University, Japan
P7	Application of Visualization of Blood Vessel Based on Visual Feedback in Diagnosis of Vascular Disease Shouren Lan, Shanghai Jiao Tong University, China
P8	Assessment of Development and Growth Patterns of Autosomal Polycystic Kidney Disease of Kidney Using CT Images Yoshihisa Matsunaga, Chiba University, Japan

December 23,2014 (Tuesday)

10:40~11:30

P1	Needle Tip Detection by Electro-Localization using a Phantom for a Needle Electromyogram Test Simulator Siyu He, Chiba University, Japan
P2	Quantitative Analysis of Prostate Cancer Using Ultrasonic Microscope Hiroaki Sugimoto, Chiba University, Japan
P3	Investigating the Effect of Synchronized Afferent Stimuli on Mirror Therapy Daito Tsujitani, Chiba University, Japan
P4	Detection and Quantitative Measurement Longitudinal Changes in Retinal Images Benzhi Chen, Shanghai Jiao Tong University, China
P5	Optical Flow Based Semi-Automatic Analysis of Ultrasound Images of Muscle Activation Shota Kawamoto, Chiba University, Japan
P6	Mental Workload Evaluation of Sensory Feedback Systems for Prosthetic Application Natsuki Hayata, Graduate School of Engineering, Chiba University, Japan
P7	Miniature Built-in Antenna at Low Frequency Xiaofang Tang, Southeast University, China

Physics-based Optimization Design of Broadband Folded Dipole Antennas through Manipulations on Smith Chart

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Purpose:

A printed folded-dipole antenna of length l and radius a can be made optimally broadband (≈ 40%) with just a few steps of manual manipulation in the Smith chart, on the frequency locus of the folded-dipole. The optimization design procedures are quite simple due to the physics-guided manipulations. During the manipulation steps, the structure changes of the printed folded-dipole is linked with the changes of locations of and speed along the frequency locus, around the Smith chart center. The results indicate the validity of the optimized design method.

Methods:

In the design of microwave devices, the sophisticated optimization system has become as significant as the powerful simulation of the three dimensional (3-D) full-wave electromagnetic (EM) simulators. Therefore, the numerical optimization becomes an integral part of the design process. It is the advancement of computer speed and developments of numerical techniques that make it possible to do optimization numerically with a computer. Until now, many optimization techniques are studied like Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Biogeography Based Optimization (BBO), etc. The most popular one in the EM field may be the space-mapping (SM) algorithm. The SM utilizes a speedy "coarse" model (typically an empirical circuit simulation) to come quickly near the optimal design, and then a slow but accurate EM-based "fine" model (typically a full-wave EM simulation) is used to do the more precise final optimizing.

This work is an attempt for the improvement to make the optimization with more physical considerations and years of past experience, insights and studies in EM physics, like capacitance, inductance and circuits. The experiences could be included along the optimization process and the optimization may be simpler and faster. In this paper, the manual optimization method on Smith chart is taken for the bandwidth enhancement of printed folded-dipole antenna on a dielectric slab, and the optimization procedure is physically guided by the well-known radiation impedance formulas of folded-dipole.

Conclusions:

The optimization design of broadband folded-dipole antenna through manipulations on Smith chart is presented in this paper. In our method of Smith chart locus manipulations, guided by physics, the adjustments of 6 parameters (D, a_l, a_r, l_t, a_D and Z_0), and 3) of the folded-dipole antenna through simple guidance by human hand is carried out on the 2D surface of the Smith chart, the resulting bandwidth of the antenna can be up to 40%, while the bandwidth of the initial folded-dipole is only 12%. On the other hand, if the optimization is to be done automatically by a numerical optimizing-software such as GA or PSO as mentioned in the Introduction, with 6 parameters to optimize and without physical insight, the computing time is likely to be much longer.

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Education & Training

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Selected papers

[1] Y. M. Chang, W. Q. Che, Y. Han, and Y. L. Chow, "Broadband dual-polarization microwave absorber based on broadside-folded dipole array with triangle-lattice cells," *IEEE Antennas and Wireless Propagation Letters*, 2014, 13, pp. 1084-1087.
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A Sematic Map Based Approach for Seamless Interaction between Mobile Service Robot and Human Users

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Purpose:
In a human-robot strongly collaboration system, such as smart wheelchair, how the robot understand human user's command and how the human user can help the robot to understand the environment are open problems. The human user usually describes the environment by instance, as well as the property of the instance and the relation between instances. However, the robot usually describes the environment by metric or topological. Therefore, our approach is that the robot understand the human user's meaning directly. We design a human centered sematic map (HC-SM for short) to bridge the gap between the human user and the robot. HC-SM can be generated by both the human user's nature command and the robot observation.

Methods:
The purpose of our method is to build a map which can communicate with both human and robot. This map follow the logic that how the human cognize and describe the environment as well as how the human send the command (usually orally). This map is defined as human centered semantic map (HC-SM). HC-SM is composed of the instance and the relation. The instance is an independent part of the space, including object, room, etc. Each instance contains property, category and action. The property of the instance is obtained directly from the sensor or by simple convert from the sensor information, such as color, size, shape or other feature. The action is how the instance can interact with the robot, such as the robot can dock into the deck. Both the category and the action are inferred from the property and the relation. The relation contains position and affiliation. The affiliation describe that an instance is a part of another instance, such as "a door has a handle", or an instance is in/on another instance such as "the desk in the room".
Searching is a fundamental topic in robotics. In this paper, the goal of searching is to find the object which is described by human user as less motion of robot as possible. The main idea is to decision which place the target object most looks like at. Since the environment is unknown, and the observation of robot is only a part of environment, the robot should predict the location of target object by the incomplete environment information. The robot can get more information by moving around, but it against the goal that as less motion as possible. Consequently, an optimization method is designed to control the robot search behavior.

Results:
The system is tested in an office environment. The robot can get the oral command of user to search an object. And the speed of search is faster than the system using an uninformed search method.

Conclusions:
This method bridge the gap between the human user and the robot. With this method, the robot can understand the description of environment by human user. And an approach of

active object searching in unknown environments using human centered sematic map is described. This searching method reduce the motion of robot.

Challenges and future requirements:
Compared with other active searching mothed based on semantic map, the proposed method needs the human user enter more complex information to describe the target object. This is because we want the robot to search an object which is similar to some other object in the environment and can be distinguish by the relation with the object around. And in the future, the information from the human user can be used to train the robot. The robot can learn in lifelong by interactive with the human user and the environment.

Biographic

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Education & Training

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Selected papers

[1] Wei, Z., Chen, W., Wang, J.: Semantic Mapping for Smart Wheelchairs Using RGB-D Camera. Journal of Medical Imaging and Health Informatics 3, 94-100 (2013)

[2] Wei, Z., Chen, W., Wang, J., Wang, H., Li, K.: Semantic Mapping for Safe and Comfortable Navigation of a Brain-Controlled Wheelchair. In: Su, C.-Y., Rakheja, S., and Liu, H. H. (eds.) Intelligent Robotics and Applications. LNCS, vol. 8102, pp. 307-317. Springer, Heidelberg (2013)

[3] Wei, Z., Chen, W., Wang, J.: 3D semantic map-based shared control for smart wheelchair. In: Su, C.-Y., Rakheja, S., and Liu, H. H. (eds.) Intelligent Robotics and Applications. LNCS, vol. 7507, pp. 41-51. Springer, Heidelberg (2012)

Evaluation on Heating Performances of Microwave Scalpel for Surgical Operation

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Purpose:
In modern surgical operation, biological tissue coagulation device such as electrical scalpels and ultrasonically activated devices have widely been used. These devices are essential surgical tool. However, these devices have some problems such as excessive heating, cavitation, and so on. Therefore, in this study, microwave scalpel, which can incise biological tissue without breeding, is developed. Moreover, heating characteristics of the device is evaluated by numerical calculations of electromagnetic field and experiments using a prototype device.

Methods:
Proposed device has loop shaped heating antenna on the tip of coaxial cable. The heating antenna is also used as the blade for cutting the biological tissue. Electromagnetic field around the device is analyzed by finite-difference time-domain (FDTD) calculations. This technique is widely used for performance evaluation of microwave antenna. In this study, thermal effect by electric field of biological tissue around the antenna was evaluated by this method. In addition, capability for tissue coagulation of prototype device was evaluated by *ex-vivo* experiment using biological tissue.

Results:
As a result of numerical calculation, concentration of electric field around heating antenna was observed. This result implies that proposed device is effective for coagulating the biological tissue. Moreover, biological tissue coagulation was realized by prototype device.

Conclusions:
In this study, microwave scalpel was developed. Moreover heating characteristics of proposed device was evaluated by numerical calculations and experiments. As a result, effectiveness of the proposed device was confirmed.

Challenges and future requirements:
As a further study, heating characteristics in surgical operation of prototype device will be evaluated in animal experiment.

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Education & Training

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Selected papers

[1] Kenta SUZUKI, Yuta ENDO, Yoshito TEZUKA, Kazuyuki SAITO, Masaharu TAKAHASHI, and Koichi ITO, “Development on microwave forceps for coagulation of biological tissue,” Bioelectromagnetics Society and European BioElectromagnetics Association for the Annual Joint Meeting (BioEM2014), Cape Town, South Africa, PB-12, June 2014.

[2] Yuta ENDO, Kenta SUZUKI, Yoshito TEZUKA, Kazuyuki SAITO, Masaharu TAKAHASHI, and Koichi ITO, “Development of forceps type device for biological tissue coagulation by microwave energy,” 31st URSI General Assembly and Scientific Symposium, Beijing, China, Aug. 2014.

SAR evaluation of 1.2 GHz band wireless camera using a tissue-equivalent solid phantom

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Purpose:
Until now, the 700 MHz band is used for the Field Pickup Unit (FPU), which used for live broadcasting, such as marathons and long-distance relay race. However, the frequency band is planned to migrate to 1.2 and 2.3 GHz bands by the action plan for radio spectrum reallocation developed by the ministry of internal affairs and communications, Japan. As the frequency migration of FPU, the size of transmitting antennas can be downsized. Therefore, the antennas for 1.2 and 2.3 GHz also will be mounted on wireless cameras for professional-use. However, the microwave, which is emitted from transmitting antenna to be mounted, has the thermal effect on the human body. As the wireless cameras are used on operator's shoulder and transmitting antenna is close to the head, the thermal effect of the microwave should be considered.

Methods:
In this study, assuming that using 1.2 GHz band wireless camera, we measured the amount of electromagnetic wave exposure using a tissue-equivalent solid phantom. As an evaluation index of the electromagnetic wave exposure when using the wireless camera, we employed the specific absorption rate (SAR [W/kg]). As the SAR measurement method, we used thermographic method because it is able to measure SAR distribution of the surface of human head, which probably the highest SAR value site in this study. Subsequently, we numerically calculated the SAR distribution under the same condition as in the measurement. We compared the measured results with the calculated results, and evaluated the measurement method whether it is appropriate. Then, we evaluated amount of the electromagnetic wave exposure when using wireless camera.

Results:
The measured results of the SAR distribution are almost consistent with the calculation results. Elevation of the SAR was observed at the right occipital of the phantom, which is close to the transmitting antenna on the wireless camera.

Conclusions:
In this study, we measured the SAR distribution on the human body using a tissue-equivalent solid phantom. Then, we also calculated SAR distribution, and compared both results. According to the results, SAR elevation was observed around ear. We should continue the detail analysis of the results.

Challenges and future requirements:
As a future study, we also will consider that the effect using 2.3 GHz band wireless camera.

Dual-band diversity Antenna for Mobile Phone diversity antenna

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Purpose:
Antenna is an integral component of the Wireless communication system, its performance is related to the quality of communication systems. The rapid development of wireless communication technology calls more stringent antenna requirements. Multiband, broadband technology and miniaturization of the antenna drew concerns in the past decade. A dual-band diversity antenna for mobile phone was designed. The design of the diversity antenna expands the bandwidth and solves the antenna layout problem.

Methods:
Using a metal frame as the main radiating element, with examples and theoretical PIFA antenna structure, combined with a special phone structure, a dual-band diversity internal antenna is designed. The design uses two different resonant paths to generate two separate resonant modes for dual-frequency operation, one path is loop structure and the other uses a coupling structure to strengthen the radiation current. With the adjustment of location of gaps on the metal frame, it is easy to implement and adjust the resonant frequency. Optimizing the antenna parameters and feed positions on the ground, it has been designed to cover the requirements of return loss and radiation efficiency.

Results:
The dual-band diversity antenna has a bandwidth of 880~960 MHz and 1710~2690MHz. VSWR is less than 2 in the bandwidth covering the LTE-TDD(B3, B7)/LTE-TDD(B39, B40, B41)/GSM. The diversity antenna is omnidirectional. An excellent three-dimensional pattern have been got for the reason that the radiation zero point points to the direction of printed circuit board. The radiation pattern helps the reduction of the interference of other components

Conclusions:
The antenna unit has the merit of simple and rugged structure, low cost, wide bandwidth, less space consumption.

Challenges and future requirements:

Biographic sketch

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Selected papers

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A Multiple-Sucker Manipulator for Intra-Abdominal Underwater Surgery Support

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Purpose:
Recently, as a minimally invasive treatment process, the number of laparoscopic surgery increases rapidly. WaFLES(Water-Filled LaparoEndscopic Surgery) is an operative method suggested by Igarashi et al. Instead of pneumoperitoneum gas in usual laparoscopic surgery, WaFLES expands the intra-abdominal space using saline. It has a lot of advantages, but it causes slip and floating state. Therefore our ultimate goal is to develop a small sucker manipulator, which can adhere to and hold the organ underwater by multiple suction cups with reconfigurable surface distribution to solve the grasping problem.

Methods:
In this study, the liver was used as the organ object for different types of experiment. This is because that the liver is slippery, heavy and harder than the other organs in the abdominal cavity. First, in order to determine the most suitable suction cups for underwater application, we measured adsorption force and sideslip tolerance by using some type of suckers in the water. Second, we proposed a dual sucker system. This is because it was expected that multiple suction cups could improve both the adsorption force and sideslip. Third, we investigated the 3-cup suction assembly. The layouts of suction cup distribution tested are a straight line, a right-angle, and an equilateral triangle.

Results:
The shape had a clear influence on adsorption force and sideslip tolerance. The result shows us that the shape of bellows is the most effective. And the structure with projection is useful of sideslip. The bellows with projection was decided as the most suitable shape to grasp the organs. Moreover, the binding-material with a small elastic modulus would cause the tissue between the suction cups to form a valley. Experimentally, when a valley occurred, the adsorption force tended to decrease. Thus, we determined that the elastic modulus that did not cause the valley is suitable. In the case of the 3-suction assembly, the straight line shows the best result. The right angle shows the worst, possibly due to asymmetricity of the layout.

Conclusions:
The results of this experiment showed bellows with projections is the most suitable. And suitable 2 or 3-suction assembly might increase both the adsorption force and resistance to sideslip.

Challenges and future requirements:
It is important to do more investigation by various conditions, for example different shape, different direction of force.

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Education & Training

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Application of visualization of blood vessel based on visual feedback in diagnosis of vascular disease

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Purpose:

Vascular disease is currently ranked first in the cause of human death, prevention and diagnosis of vascular disease has become particularly important. The main method is the visualization of blood vessels using CTA and MRA data. According to the existing problem of vessel visualization and developed a fast and flexible vascular visualization framework based on visual feedback mechanism.

Methods:

The algorithm framework is completed on the classical transfer function based on SG-TF. Firstly according to the prior knowledge and visual feedback results to choose appropriate transfer function space, but it faces the complex boundary-overlapping problem: different structures with similar attributes have the same region in SG-TF space, the LD-TF cannot correctly classify those structures. However, most of the structure is far away in space, which inspired us to add connectivity computation operation. The connectivity computation can correctly classify all structures that are far away in the space. So we can extract the structures of interesting. But due to the existence of PVE region and the blood vessel and other organs or tissues that are close by each other are usually connected mistakenly. Finally we introduce set operation of boundary voxels into SG-TF; it can remove the PVE region that make boundaries of two adjacent disconnect in the space.

Results:

The algorithm in this paper carried out a large number of tests in domestic clinical data, which include various kinds of data of vascular disease, such as abdominal aortic aneurysm, aortic dissection, renal artery embolization, pulmonary embolism, iliac artery aneurysms and vascular narrow disease data etc. Experimental results demonstrate that the framework has a good Visual effect for these disease data and accurately reflect changes of vascular lesion location that also obtained clinical experts praise.

Conclusions:

On the basis of the technique, this paper proposes a hierarchical processing framework to separate various boundaries in real-world 3D images that overcome these limitations of SG-TF and enhance its object classification abilities.

Challenges and future requirements:

The drawback of the algorithm is that it cannot good visualize the small blood vessels and the pulmonary vascular. The future work is that we will add the Hessian matrix or other mechanism in our framework, for that it can dectect more small vessels and pulmonary vessels.

Biographic sketch

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Education & Training

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2012 M.S., Image Processing and Pattern Recognition, Kunming University of Science and Technology

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Professional memberships

Selected papers

[1] Xiankui Li, Shouren Lan, Zhijun Zhang, Lisheng Wang. A Novel 2D Transfer Function for the Volume Rendering of Blood Vessels in MRA image, The 8th International Conference on Bioinformatics and Biomedical Engineering, 2014

Assessment of Development and Growth patterns of Autosomal Polycystic Kidney Disease of kidney using CT images

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Purpose:
Autosomal Polycystic Kidney Disease (ADPKD) is a disease that deteriorates renal function in accordance with progression of multiple cysts in the renal parenchyma. Though renal volume is an indicator of renal function, it's difficult to evaluate time to progression into renal failure. We developed a method to estimate progression speed of cysts using a CT image of the kidney and tested its relevance focusing relationship between cyst growth pattern and residual kidney function.

Methods:
Cross-sectional CT image of 10 patients with ADPKD was used to extract a group of skeleton lines that represent number and size of cysts in renal parenchyma processed using “skeletonization”. The number of lines, the distribution of its length and the number of cross points of lines were compared to serum creatinine levels that indicate kidney function.

Results:
Close relationship was revealed between the number of skeleton line, the distribution of length and the number of cross points and serum creatinine levels.

Conclusions:
Estimation of growth and development speed of multiple cysts in ADPKD would be feasible by processing CT image of renal parenchyma, and would be useful to predict adequate timing to start therapies to prolong duration to renal failure.

Challenges and future requirements:
Advanced method of processing 3D images of kidney as a 3D skeleton image to analyze growing pattern of ADPKD in mathematical model would be challenging to understand mechanism of developing ADPKD in relation to gene expression.

Biographic sketch

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Education & Training

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Selected papers

Needle Tip Detection by Electro-Localization using a Phantom for a Needle Electromyogram Test Simulator

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Purpose:

In electromyogram (EMG) study, a needle electrode is inserted in different locations and moved a number of times into the muscle to record the muscle activity to detect some pathology. At present, skills of the needle EMG tests are acquired through training with human subjects. However, it is not only painful, but also difficult to reflect different neuropathological symptoms. Therefore, a training tool is important for young medical students and clinical technologist to acquire the skills. We are aiming at developing a physical upper arm neurological simulator as the tool. A fundamental problem is the localization of the needle tip. Several solutions, such as a stereo camera based needle recognization, or electro-localization, or their combination could be considered. In this presentation, we introduce tissue-like phantom based needle tip electro-localization.

Methods:

An electrical field with a certain voltage distribution could be generated by employing a pair of electrodes on the surface and bottom of the phantom. If the electrodes were appropriately designed, the needle tip location might be accurately predicted by reading and analyzing the voltage value at the needle tip.

A phantom with isotropic conductivity and a ring electrode resulted in a pseudo-linear voltage distribution so the relationship between depth and voltage is straightforward. An experimental study was conducted to analyze the availability and precision of this method. We used AC voltage and stainless electrodes to reduce the effects of electrode oxidation. In addition, we conducted a simulation in advance (shown in Fig.1) to optimize the ring electrode size to improve the voltage linear distribution.

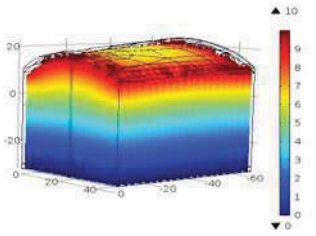

Fig. 1 Simulation of the voltage distribution

Results:

The deeper location (closer to bottom electrode) has a more linear voltage distribution than superficial locations due to the phantom shape and electrode as shown also in the simulation. As a result, accuracy is lower in superficial locations than deeper regions.

Conclusions:

The height of the needle tip could be detected with accuracy.

Challenges and future requirements:
Only one dimension (depth localization) was implemented. We need to combine this study with 3d-camera to add more dimensions and improve presicion. Also, the hardness of the phantom should be improved to be similar to the real muscle. In addition, a smaller voltage range decreased the accuracy (lower in upper region). A good way to measure voltage more accurate is to use larger input voltage. Finally, we need to improve matching between the electrode and the curved phantom surfaces to reduced false contact and achieve better results.

Biographic sketch

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Education & Training

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Professional memberships
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Selected papers
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Quantitative Analysis of Prostate Cancer Using Ultrasonic Microscope

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Purpose:
The purpose of our study is to estimate the acoustic properties of prostate cancer using ultrasonic microscope and to detect the cancerous sections in diagnostic images quantitatively and automatically. While the current treatment of prostate cancer have the high survival rates in stage Ⅰ, Ⅱ and Ⅲ, the important problem to solve is the risk of complications associated with radical treatment. Detection of small lesion by some imaging apparatuses is a clue for "focal therapy" that minimize therapeutic invasiveness and preserve organ function.

Methods:
Paraffin-embedded specimen from three patients with prostate cancer was sliced at 8 micro-meters thick. We measured SoS and attenuation by ultrasonic microscope at frequency of 80 MHz, and compared the measurement values in cancerous and non-cancerous regions with pathological findings. Then we calculated the precision in discrimination between cancerous tissue and normal parenchyma using image clustering.

Results:
Cancerous regions showed lower medians and lower IQRs in both of SoS and attenuation than non-cancerous regions ($p<0.01$). And images of ultrasonic microscope can be divided into two feasible areas by image clustering.

Conclusions:
Acoustic property of small lesions of prostate cancer was estimated quantitatively by ultrasonic microscope. The image clustering provided a method of high sensitivity detection of cancerous region.

Challenges and future requirements:
Further study is required to improve accuracy of our system and to take our system to conventional ultrasonography in order to visualize small lesions in the clinical field.

(Declaration: The content of the abstract was presented in "32nd World Congress of Endourology & SWL" in Taipei)

Biographic sketch

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Education & Training

2013 M. Eng. of Department of Medical System Engineering, Division of Artificial System, Graduate School of Engineering, Chiba University
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Professional memberships

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Selected papers

No paper

Investigating the effect of synchronized afferent stimuli on mirror therapy

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Purpose:
The purpose of this study is to investigate the effect of synchronized afferent stimuli during mirror therapy. Mirror therapy and bilateral exercise belong to a class of neuro-rehabilitation for stroke and other motor-function impaired patients, in which a patient moves his healthy limb while watching the mirrored images of the limb, to cause the mirror illusion that his paralytic limb is moving. It has been shown that, mirror therapy could encourage function recovery by causing the mirror illusion to improve the coupling between limbs. On the other hand, from the viewpoint of human multimodal sensory information processing, it is reasonable to hypothesize that the proprioceptive sensory feedback might be integrated with the visual information to play a role in the mirror therapy. In this study, we investigated the effect of synchronized afferent stimuli on mirror therapy.

Methods:
In the experiments, normal subjects were functional MRI scanned while performing 3 different tasks: 1) right hand finger-tapping, 2) vibration stimulus to left forefinger, 3) right hand finger-tapping and vibration stimulus to left forefinger. We analyzed the fMRI data by subtracting task 1 and 2 from task 3.

Results:
Activation in right and left cerebellum motor area and somatosensory area were made clear from the fMRI data analysis.

Conclusions:
Motor area and somatosensory area activation suggest the possibility of combining afferent stimulus to the motor-function impaired limb, and healthy limb movement for the function recovery of the impaired limb that could not perform any voluntary movement.

Challenges and future requirements:
In this stage, we experimented with normal subjects. The study with motor-function impaired subjects, such as after-stroke patients, is needed in future. Furthermore, measuring improvement of motor function by motor function tests should be done.

Biographic sketch

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Education & Training

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Selected papers

Detection and Quantitative Measurement Longitudinal Changes in Retinal Images

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Purpose:
Monitoring pathological varying tendency in the same longitudinal time-series retinal images is of widespread interest in ophthalmology, especially quantitative measurement variation areas of couple retinal images over time can help ophthalmologists to distinguish the abnormality and assess whether the treatment strategy is effective to the patient.

Methods:
In order to reduce the influence of the noise and inconsistent intensity of two retinal images, the intensity values in one image are normalized to have the same mean and variance as those in another. The retinal images were always misaligned because they were taken at different times or different fields of view. So they were spatially aligned by a retinal registration method before acquisition difference images. After image intensity normalization and registration, two co-registered images are compared to generate the change difference image.
Intensity values subtraction method could locate positions of changed regions accurately while it was sensitive to noise, but texture analysis behaved in the opposite way. Therefore, multi-attribute subtraction was applied to acquire changed images. As intensity normalization and registration errors may bring some false changes, robust principal component analysis technique (RPCA) was applied to reduce these errors and generate a retinal RPCA difference image. At last, weighted fuse rules were used to integrate multi-attribute difference image and sparse component to enhance the robustness and accuracy of detection longitudinal changes.

Results:
It was tested on 8 pairs of longitudinal time-series retinal images. The experimental results show that by using integrating multi-attribute of images and RPCA for change detection, one can acquire better change detection results and more accuracy changed areas measurement than exploiting the single differencing image or rationing image.

Conclusions:
To monitor retinal pathological varying tendency, we have developed a computer-aided lesion change detection and quantitative measurement changed areas system. It was praised by ophthalmologists and had fine clinical value in the field of ophthalmology.

Challenges and future requirements:

There are two mainly challenges:

1) As the longitudinal time-series retinal images were taken at different angles and positions, then may lead to image deformation , It was very difficult to align fully two images;
2) The pixel intensity values in one image can not be completely normalized to another;
3) It is a challenge to retain all true changed regions and discard all unchanged information.

Future requirements:

1) It is an exciting thing to develop a uniform and effective method for change detection;
2) To aid less experienced physicians to image analysis-based decision support is an important research domain.

Biographic sketch (SAMPLE)

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Professional memberships

Selected papers

Optical Flow Based Semi-Automatic Analysis of Ultrasound Images of Muscle Activation

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Purpose:
EMG is an effective way to measure muscle activity, but it presents limitations such as signal contamination during electrical stimulation. An alternative method to investigate muscle activity is ultrasound imaging (UI). It provides a non-invasive way to investigate the activities of both surface and deep muscles in real time even during electrical stimulation. In UI, muscle thickness and pennation angle are benchmark features of muscle activity. But it is time consuming task to measure these features manually. In this study, we tried to improve the optical-flow based measurement to increase the speed of calculation.

Methods:
We proposed semi-automatic measurement by optical flow. We estimated some types of optical flow; Horn&Schunck (HS), Lucas-Kanade optical flow algorithm with an affine optic flow refined Pyramidal Lucas & Kanade (PLK). We used the movie of the motion; voluntary contraction, the contraction by electrical muscle stimulation. First, we selected lines to calculate muscle thickness and pennation angle in the first frame of continuous images. These lines were moved by optical flow in next frame and were used to calculate muscle features. And we inserted an angle line relocation process for the quick motion due to electrical stimulation. Further, an enhanced PLK was proposed to improve the efficiency and accuracy of the optical flow based line tracking. Manually extracted pennation angles and mucles thickness were used as reference.

Results:
Muscle thickness and pennation angle were tracked accurately by PLK and AF respectively. So, the combined method (AP) by using PLK and AF to track muscle thickness and pennation angle respectively was tracked accurately than other optical flow separately. In the motion during electrical stimulation, results with relocation were significantly better than that without relocation. And AP was much faster than manual measurement.

Conclusions:
In order to track the pennation angle and the muscle thickness at a higher accuracy, and at a reasonably lower computational cost, this study focused on the accuracy of optical flow and the error due to quick motion. We were able to track the pennation angle and the muscle thickness faster by utilizing AP than manual measurement.

Challenges and future requirements:
As our future work, we will increase the number of subjects and increase tracking accuracy. The out-plane movement of ultrasound measurement shall be taken into consideration. And we would like to investigate the mechanism of muscle activity by using this algorithm.

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Mental Workload Evaluation of Sensory Feedback Systems for Prosthetic Application

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Purpose:
For amputees, because of their complete lack of kinesthetic and tactile information, vision becomes the only feedback channel available for them to monitor and guide the prosthesis manipulation. However, relying on vision in long-term daily use may increase the cognitive burden, which leads to fatigue and frustration. For these problems, there are many studies to develop the feedback system using other sensory input, such as electrical, vibration, force stimulus, and sounds. However, they didn't touch on cognitive burden of these systems. In this study, we measured the mental workload during using the feedback system.

Methods:
Regarding implementation of the dual task paradigm subjects were required to perform a primary task by their right hand, and a secondary task by their left hand, simultaneously.
As the primary task, subjects were asked to perform the grasping task using prosthetic hand and 2 types of feedback system. We used the auditory feedback system developed in our group, and the visual feedback system which conveys the same information from the head mounted display. As the secondary task, we gave the oddball task to measure the mental workload and evoke the event related potential (ERP) from the brain wave. For the stimulus of the oddball task, vibration stimulus was given to back of the left hand or upper arm of each subject with a probability of 2:7 at random. Only when the subject felt a stimulus to back of his hand (target stimulus), he was required to react by pressing a switch. Time to response to the target stimulus and response rate to the target stimulus were recorded as the mental workload indicators. And we recorded the P300, one of the components of the ERP, which reflects the selective attentional demands assigned to the target stimulus. Furthermore, as the subjective measurement, subjects were asked to answer the NASA-TLX after the experiment, and as the stress indicator, we measure the ECG during the experiment.

Results:
The P300 and the other parameters of the oddball paradigm revealed the difference between different sensory feedback modals.

Conclusions:
Considering prosthetic application's long-term use in daily living, its sensory feedback should be evaluated by not only performance indexes, but also its cognitive burden. The oddball paradigm might be a suitable way to evaluate the mental workload.

Challenges and future requirements:
From the results, we will start up to design new feedback systems and control systems of the prosthetic hand, which reduces users' mental workload.

Presentation type (please select one of the below options):
Poster Presentation (only for students)
Biographic sketch

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Education & Training

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Miniature built-in antenna at low frequency

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Purpose:
The present study is aimed to design a miniature antenna working in the low frequency band (0.4-0.45 GHz) which can be integrated in small wireless electronic products. Currently wireless electronic products market has become especially crowded and competitive. And the products which are compact and easy to carry get the customer's more attention. Nowadays antenna miniaturization technology is not mature enough to keep up with the pace of the demands, and often becomes the bottleneck of reducing the products' volume. So the design of miniature built-in antenna becomes very meaningful. As we know, the frequency band and gain of antenna determine its size. When the frequency is constant, reducing the size of the antenna will inevitably lead to the deterioration of efficiency, gain, and other properties of the antenna. However, under certain parametric conditions, we still can appropriately reduce the antenna size, in order to achieve the purpose of miniaturization.

Methods:
This study proposed two miniature built-in antennas for small wireless electronic products, like smart metering and smart plug.
The first antenna combines the design theory of helical antenna and inverted F structure. As the input impedance is not very sensitive to the change of operation frequency, the helical antenna has the advantages of small size, light weight and bandwidth. And inverted-F structure is suitable for size-constrained applications. The whole antenna is constructed on one side of the PCB (FR4), the radiation part is due to a helical structure and the feeding part is an inverted F structure.
The second antenna is a hybrid design between a PIFA and the patch of winding strip structure. The whole antenna is placed on the top of the PCB (FR4) and consists of an inverted-F metal strip. The volume is about 50mm*10mm*2mm.
Both the above antennas require additional matching circuit to let VSRW<2.

Results:
The characteristics of the presented miniature antennas are simulated and optimized by HFSS and ADS. The simulation results of them are performed well in terms of operated frequency band and size respectively. The first antenna works at the center frequency point 420MHz with the gain reaches -8.5dB and the second works at 440MHz with the gain-8.68dB. The peak radiation pattern occurs at the vertical plane of PCB. The radiation patterns for the two designs are nearly omni-directional.
Conclusions:
In this study, two miniature built-in antennas were designed and optimized. The two proposed antennas are suitable for application in numerous small wireless devices because of its compact size, simple structure, low price and omnidirectional radiation properties.

Challenges and future requirements:
Due to the simulation results of the designed antenna, the gain is still low. In the future studies, besides the miniaturization technology, how to improve the gain of the miniature antenna becomes a research direction.

Biographic sketch

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Education & Training

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Professional memberships

Selected papers

[1] Xiaofang Tang, Xiaowei Zhu, Zhenqi Kuai, "Wideband Slot Antenna for LTE Indoor Distribution Applications", Antennas and Propagation Society International Symposium (APSURSI), 2014 IEEE, pp. 1841-1842, July 2014.

A Virtual Simulation and Driver Evaluation Platform for Smart Wheelchairs

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Purpose:
Today, many people especially for the elderly and disable people, are difficult to operate a manual wheelchair and have to rely on an electric wheelchair to complete their daily navigation tasks. Electric wheelchairs are believed to increase the mobility of individuals with mobile dysfunction and make them to live more independently. So safe and smooth operation is necessary for them to get enough driving skills. Thus in our lab a simulator platform of smart wheelchairs is developed for driver training and evaluation. Without nursing staff's accompany, the user could complete driver training and assessment procedure by himself.

Methods:
Integrated with dynamics, kinematics, sensors, and the 3D models of world and wheelchair, a comprehensive platform for both driver training and evaluation of electric wheelchairs is presented and implemented in Gazebo and ROS. Equipped with various sensors such as encoder ,laser range finder and a on-board computer, it could record the process data during training and give the final evaluation results. Based on the simulation platform, we also propose the training and evaluation standards and procedures for electric wheelchair divers. So in the simulator platform, the user could complete driver training and assessment procedures by user self without nursing staff’s accompany.

Results:
Based on large numbers of experiments, the designed training was proved to effectively improve user’s driving efficiency, without difference between simulation and real platform. And the training effect on simulation platform is much better than that of no trainings.

Conclusions:
The simulation platform indeed has similar functions and consistent results to the real electirc wheelchair. It could be applied as a training and evaluation platform for electric wheelchair drivers.

Challenges and future requirements:
Compared to virtual world, real world and environment is more complicated and fast-changing, so the results generated from our simulation platform cannot completely represent the skills or performance that a user drives a real electric wheelchair. The next stage we plan to do is to make the simulation platform more realistic and vivid as the real world.

Presentation type (please select one of the below options):

☐ Oral Presentation

☐√ Poster Presentation (only for students)

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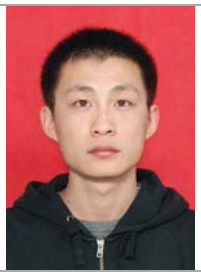

Education & Training

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Selected papers

[1] Li Liu, Jingchuan Wang, and Weidong Chen. "A Virtual Simulation and Driver Evaluation Platform for Smart Wheelchairs." Life System Modeling and Simulation. Springer Berlin Heidelberg, 2014. 307-318.