## *Europe-Japan Technology Exchange toward Contribution of IRT to Medical Care and Welfare -from Physical to Cognitive Assistance-*

7 March 2011
Katholieke Universiteit Leuven

### PROGRAMME

**Opening**

10:00 E.Vander Poorten Welcome word by workshop organizers K.U.Leuven
10:05 Yasuyoshi Yokokohji Brief introduction of Kobe University and its IRT research activities Kobe University

**Session 1** Physical assistance for medical and welfare applications

10:15 Herman van der kooji Lower extremity powered (wearable)assistive and therapeutic exoskeletons T.U.Twente
10:35 Zhiwei Luo On RI-MAN Shock-Physical Interaction between Human and Robots Kobe University
10:55 David A.Abbink Sharing control through haptics:feeling is believing T.U.Delft
11:15 Thierry Janssens VESALIUS laparoscopic robot K.U.Leuven
11:35 Sarthak Misra Robotically Steering Flexible Needles T.U.Twente
11:55 Lunch

**Session 2** Cognitive assistance for medical and welfare applications

13:15 Bernard Pauwels Building and home technologies for people with disabilities and elderly InHam
13:35 Hiroshi Kawaguchi Low-Power Signal and Information Processing for Speech Communication Kobe University
13:55 Marie-Elisha Lerouge Zenio elderly monitoring Verhaert
14:15 Wolfgang Eberle Variations on brain-computer interfaces in medicine and pharmacology:in vivo and in vitro IMEC
14:35 Coffee Break
14:50 Eric Demeester Cognitive assistance for powered wheelchair navigation and the RADHAR project K.U.Leuven
15:10 Yasuyoshi Yokokohji Method for Extracting Support Needs from People with Early-Stage Dementia to Maintain Their Social Living Kobe University

**Session 3** Japan-Europe Collaboretion funding opportunities(FP 7 -ICT-HEALTH)

15:35 Takashi Okunishi Introduction of Kobe University Brussels European Centre(KUBEC) Kobe University
15:45 Herman Bruyninckx European Robotics Network K.U.Leuven
16:05 Zhiwei Luo Health Engineering for Aging Society Kobe University
16:25 Coffee Break
16:45 Greet Bilsen & Stijn Delauré Japan EU Collaboration in FP 7 ICT and Health Programs Leuven LRD & D.O.C.
17:05 Stephan Pascall Japan-EU collaboration in ICT EC
17:30 Panel Session:E.Vander Poorten,Y.Yokokohji, Z.Luo, H.van der Kooji, H.Bruyninckx, Stephan Pascall
17:55 Yasuyoshi Yokokohji Closure of meeting and welcome to the reception. Kobe University

Reception

## 1. Introduction

Japan and Europe are both facing a rapidly ageing society. They need to urgently address similar challenges if both want to maintain the current quality of living for their citizens. Information and Robotics Technology (IRT) is seen as an essential instrument in order to face these challenges and both Japan and Europe are strong players in this field. Collaboration between Europe and Japan on IRT development to assist people not only physically but also cognitively could speed up developments, resulting in more general applicable and sound solutions to the common challenges posed by our ageing societies.
This workshop, organized by Kobe University and K.U.Leuven, is a part of the Opening Symposium of the Kobe University Brussels European Centre in short KUBEC (http://www.office.kobe-u.ac.jp/opie/kubec/). The goal of this workshop is to get an idea of activities on these issues in Europe and respectively Japan and to see how/if/when collaboration could be possible. The objective of this workshop can be seen in the following statement shown in the workshop brochure:
"Information and Robotics Technology (IRT) is expected to play a vital role in dealing with the aging society, by assisting people not only physically but also cognitively. European countries are very advanced in the field of medical care and welfare, and many research activities dealing with IRT are ongoing. Also in Kobe University a healthcare engineering research group was established. The group includes not only engineers, but also health science researchers. The aim of this group is to utilize IRT effectively to progress healthcare and welfare. In this workshop, we will exchange ideas between Europe and Japan, aiming at the contribution of IRT to medical care and welfare. We will also discuss Europe-Japan Collaboration funding opportunities."
This report is a short summary of the ideas that were exchanged during this one day workshop in the mechanical engineering department of the K.U.Leuven (Heverlee, Belgium).

## 2. Program

The workshop can be divided in three sessions. Two research oriented sessions covered activities in EU and Japan on respectively physical and cognitive assistance technology. The target of the third session was to get an idea of how this type of research activities are currently conducted/ supported/ funded in EU and Japan and whether/how collaboration on these issues between EU and Japan could/should take place. A panel session on this issue concluded the meeting.

## 3. Participants

About 50 people participated in the workshop. The participants include professors and researchers from K.U.Leuven, U.Libre de Bruxelles, T.U.Delft, T.U.Twente, and Univ. of Hasselt etc. Researchers and engineers from some private companies such as IMEC, Maxon Motor, Verhaert, InHAM also participated. It should be noted that we have a participant from European Commission who is in charge of the European Framework Program on ICT and we could have an opportunity to discuss on research collaboration between Europe and Japan in the workshop.
From Kobe University, four professors participated, Prof. Takashi Okunishi (Director of KUBEC), Prof. Zhiwei Luo, Assoc. Prof. Hiroshi Kawaguchi, and Prof. Yasuyoshi Yokokohji (co-organizer of the workshop).

## 4. Summary of the talks

**Session 1 Physical assistance for medical and welfare applications**
**"Lower extremity powered (wearable) assistive and therapeutic exoskeletons" by Prof. Herman van der Kooij**

The session was started by the talk by Prof. van der Kooij. He presented the LOPES (LOwer-extremity Powered ExoSkeleton) project. The goal of the LOPES project is to develop a robotic device (LOPES) for gait training and assessment of motor function in stroke survivors. This involves designing the mechanical setup of the exoskeleton as well as its control structure. LOPES will be used to optimize the functional outcome of (robot-aided) gait training in chronic stroke survivor.

**"On RI-MAN Shock - Physical Interaction between Human and Robots" by Prof. Zhiwei Luo**

Prof. Luo presented the development of a human care robot RI-MAN. He emphasized that to support human care tasks, it is more important to estimate the cared person's motion ability as well as his/her emotion. The influence from engineering support to the human's motor function should be taken into account.

**"Sharing control through haptics: feeling is believing" by Prof. David A.Abbink**

Prof. Abbink introduced the concept of haptic sharing, shared control by human and machine through haptic information. He first showed haptic gas pedal of automobile where the reaction force of gas pedal changes depending on the distance from a car in front. Important point is that the system just indicates the possibility of collision in the future and the driver can keep the current speed if he wants by resisting the reaction force and keeping the current angle of gas pedal. He then introduced a new application to steering control. Adjusting neutral position and stiffness of the steering wheel, it is possible to guide the driver to keep the lane, changing the next lane, and changing the lane in either way to avoid the collision.

**"VESALIUS laparoscopic robot" by Dr. Thierry Janssens**

Dr. Thierry Janssens (K.U.Leuven), member of the Robot Assisted Surgery group of the K.U.Leuven https://www.mech.kuleuven.be/en/pma/research/ras, introduced the recent developments around the VESALIUS surgical robot platform, developed at K.U.Leuven. This patent-pending platform is used for surgical assistance during minimal invasive laparoscopic interventions. Compared to the famous Da Vinci® robot, this is a compact, low-cost solution, with reduced functionality. The robot features a compact adjustable remote centre of motion. This is necessary to align the remote center of motion created by the robotic mechanism with the entry-point in the human's body. This is where a lot of space is gained as compared to the Da Vinci® robot that relies on voluminous arms to position the remote center of motion (patent by Blumenkranz). Next to a robot for laparoscopic laser surgery, which is being commanded through a writing pad, a laparoscope holder and a passive version of this system were developed and tested. Experimental results showed fast learning effects and improved operation effectiveness as compared to manual laparoscopic interventions.

**"Robotically Steering Flexible Needles" by Dr. Sarthak Misra**

Dr. Misra presented a unique needle insertion system by using a needle with asymmetric bevel tip. Needles with asymmetric bevel tips naturally bend when they are inserted into soft tissue. By rotating the needle, it is possible to control the bending direction and let the needle tip reach the designated location in the tissue. He presented an analytical model for the loads developed at the bevel tip during needle-tissue interaction. The modeled transverse force developed at the tip was compared to forces measured experimentally.

**Session 2 Cognitive assistance for medical and welfare applications**
**"Building and home technologies for people with disabilities and elderly" by Dr. Peter Deboutte**

Dr. Deboutte introduced the activities of In-HAM vzw. In-HAM provides opportunities of crossing a bridge between the technology (construction, mobility, communication, home automation) and the solution that assistive technology supplies for the disabled and elderly person.
In-HAM promotes research on existing and new building and home technologies taking into consideration the critical judgment of the end-user, his closest environment and the therapist. In-HAM also offers services to users with disabilities to achieve a qualitative adaptation of their living environment, to building constructors from the care and housing industry to the industry that gets opportunities to develop products that stand a real chance to be commercialized. The end-user will have an opportunity to test existing and recently developed aids on their validity. The end-user experience is a feedback for the manufacturer and a way to optimize the product through which the developed technology has more chance for a significant use.
Dr. Deboutte also introduced a companion robot developed by a European project in which In-HAM was involved.

**"Low-Power Signal and Information Processing for Speech Communication" by Prof. Hiroshi Kawaguchi**

Prof. Kawaguchi covered two topics in his speech. After talking about research on ubiquitous sound acquisition and processing through a microphone array network, Prof. Kawaguchi introduced current research on a large-vocabulary speech recognition system. An ubiquitous sound acquisition system has as major benefit that it can record high-quality sound from any location within a room, without the need for a nearby microphone. E.g. speakers are do not longer need to be conscious of a microphone or its location. Through noise reduction and speech enhancement techniques non-relevant sounds can be filtered out. Sound is captured through a large array of microphones located at the walls of a room. These locate the sound source, record and process the data. Prof. Kawaguchi introduced a distributed processing scheme that allows fast calculations while maintaining a good quality. Once data is captured speech recognition techniques can be applied. Also in this domain Prof. Kawaguchi is active. During the second part of the speech a hardware approach for speech recognition developed at Kobe Univ. was introduced. The developed algorithms realize speech recognition at high accuracy, low power, yet cover a large-vocabulary database. It is not hard to imagine how these techniques when they become available at low price could result in domestic

applications that help people to live longer in an independent way.

**"Zenio elderly monitoring" by Dr. Marie-Elisha Lerouge**

Dr. Lerouge introduced Zenio Fall Detector developed by Verhaert. The intelligent fall detection device was developed in collaboration with Antwerp University. This intelligent device can detect 2 phases fall and recognize more than 10 different types of fall, eg. forwards, side wards, backwards, falling/gliding from chair, sliding, falling out of bed etc. Main features of this device include smart fall detector, emergency alarm button, Bluetooth connection, call (using a mobile phone) and SMS messages. The benefits of this device are reducing fear for falling and providing reassurance and more confidence to maintain an active, independent and self-sufficient lifestyle. The device is very user friendly with LED indication and buzzer, large panic button and allowing deactivation of alarm by a user. It has Zen inspired design. It is extremely reliable and provides permanent monitoring. Dr. Lerouge also mentioned a next generation of fall detector which is integrated with PDA or cell phone.

**"Variations on brain-computer interfaces in medicine and pharmacology : in vivo and in vitro" by Dr. Wolfgang Eberle**

Dr. Wolfgang Eberle is Program Manager of IMEC's Cell Interfacing Technology and Manager of Bioelectronic systems. In this talk Dr. Eberle talked on variations on Brain Computer Interfaces in Medicine and Pharmacology. At present a plethora of brain-computer interfaces exist with different levels of invasiveness. IMEC is actively investigating a bottom-up approach for brain computer interfacing starting from interfacing a cell and molecular level. Depending on the purpose at hand: cellular function, disease research, drug discovery, medical therapy, interfaces need to be made at different levels. With different kind of cells or tissue types : neuronal, cardiac, fibroblast, auditory or olfactory,... under different conditions: dissociated cells, cell cultures, acute slices, cultured slices, acute in vivo or even chronic in vivo. In his speech Dr. Eberle went into more detail into two types of applications. First he discussed 'in vitro platforms for drug screening and pharmacology' talking about interaction @ single-cell level, cell-on-chip to brain-on-chip. Next he talked about implantable Microsystems for pharmacology, therapy and neuroscience on methods to improve deep brain stimulation therapies and finding new targets.

**"Cognitive assistance for powered wheelchair navigation and the RADHAR project" by Dr. Eric Demeester**

Dr. E. Demeester introduced work by K.U.Leuven on cognitive assistance for powered wheelchair navigation. The division of PMA has a long tradition in developing assistive technology for people with physical and cognitive disabilities, through participation in several national and international projects (EU projects on this matter were MAIA, MOVEMENT , Ambience ). Recently, K.U.Leuven is coordinating the RADHAR project to develop techniques for robot adaptation during user assistance. In his speech, Dr. Demeester indicated the current state in wheelchair navigation assistance and clarified the targets of RADHAR to progress the state of the art. Wheelchairs will online identify the user characteristics (w.r.t. navigation capability) and will automatically adapt the level of assistance, presenting each user the just amount of assistance needed for safe and smooth navigation in a 3D-world.

**"Method for Extracting Support Needs from People with Early-Stage Dementia to Maintain Their Social Living" by Prof. Yasuyoshi Yokokohji**

In the area of welfare engineering, various technological research and developmental efforts have been made to support people with dementia. However, it is not clear if these efforts are based on the real needs of these people. When providing support to people with dementia, it is essential to know exactly what their needs are. Nevertheless, it is not easy to obtain appropriate answers from these people by simply asking "How can we help you?" In addition, it is unlikely that answers from those people will cover all of their support needs.
In this talk, Prof. Yokokohji presented a new method based on the "Person-Centered Care" concept for eliciting the support needs from, and determining their priorities for people with early-stage dementia who are eager to maintain their social living despite coping with various difficulties.

**Session 3 Japan — Europe Collaboration funding opportunities (FP7-ICT-HEALTH)**

**"Introduction of Kobe University Brussels European Centre (KUBEC)" by Prof. Takashi Okunishi**

Prof. Okunishi, Director of KUBEC, introduced the background how Kobe University opened the KUBEC. He also introduced what H.E. Mr. Herman Van Rompuy, President of the European Council, mentioned in the opening symposium held in the last week. Prof. Okunishi emphasized the last word by Mr. Van Rompuy: "Today is indeed the first day of: "A new era of Japan - Europe Academic Cooperation"."

**"European Robotics Network" by Prof. Herman Bruyninckx**

Prof. H. Bruyninckx, coordinator of the European Robotics Research Network gave an overview of robotics research at European level. The main stakeholders in robotics research in Europe are EURON (academic focus, gathering 229 member institutes), EUROP (industrial focus, including 120 member companies), euRobotics (a recent initiative to put one single face to European robotics) the European Commission and of course the general public. Prof. Bruyninckx discussed current activities between these different stakeholders, including the writing of a Strategic Research Agenda for robotics (SRA). This RSA is available online at http://www.robotics-platform.eu/ cms/index.php?idcat=26. European industry and academia formulated their vision how to shape European robotics to establish a viable robotics industry in Europe by 2020. This is summarized in this SRA. Increased intercontinental research on robotics could be interesting, needed to tackle aspects related to differences in culture and differences in human physiology.

**"Health Engineering for Aging Society" by Prof. Zhiwei Luo**

This talk presented the health engineering research activities. Aging problem is widely recognized as one of the most serious social problems that have never been suffered in human history. In order to activate the aging society, establish of Health Industry is necessary. Our research aims to construct the solid scientific foundation for innovation of health engineering. We mainly target on following applications with respect to the human's health levels: (1) Welfare support of healthy elderly people so as they communicate and contribute to the societies more easily and safely with happiness, (2) Training and health promotion, (3) Disease prediction and prevention, (4) Human care support, and (5) Rehabilitation of human motor functions and high order cognitive functions, by developing novel sensing and information technologies, virtual reality and robotics.

**"Japan EU Collaboration in FP7 ICT and Health Programs" by Dr. Stijn Delauré**

Dr. Stijn Delauré is Head of unit of the International Research Policy Unit of the Research Coordination Office of the K.U.Leuven. After a short introduction of the University of the K.U.Leuven, Dr. Delauré gave a brief overview on the R&D at K.U.Leuven discussing the policy context and indicating the international perspective. K.U.Leuven participates in International Networks such as the 'Coimbra group' the 'European University Association (EUA)' and LERU that binds 21 research intensive European universities. At present a number of academic collaborations between K.U.Leuven and Japan exist:

- Centrally: bilateral agreement for student & staff exchange with 'Kansai University'.
- Faculty-level: bilateral agreements on student mobility with : Osaka University (School of Engineering), Waseda University (Philosophy), Nihon University (College of Engineering) and Universities of Rikkyo, Kyushu, Shinhu, Seijo (Arts).
- Networks for cooperation: Kansai University with K.U.Leuven Faculty of Arts (Japan-EU Research Centre) and Osaka University, Hokkaido University, Keio University, University of Tokyo with K.U.Leuven Dept. of Mechanical Engineering (2003-06) .
- Large-scale collaborative research projects took place with
  - Ritsumeikan University and K.U.Leuven Dept. of Physics (FP7-INFRA)
  - Keio University, Osaka University and K.U.Leuven LICOS (FP7-KBBE)
  - Kobe University and K.U.Leuven Dept. of Pharmaceutical Sciences (FP6-NMP)

  K.U.Leuven supports joint project applications between EU and Japan that start from a bottom-up researcher's initiative.

**"Japan - EU collaboration in ICT" by Dr. Stephan Pascall**

Dr. Stephen Pascall, Advisor to the Director Directorate C "Policy Coordination and Strategy" of DG Information Society and Media of the European Commission, recently returned from a diplomatic mission to Japan with exactly this purpose, explained some issues related to setting up a framework for future 'structural' collaboration on ICT between EU and Japan (top-down).

- For example it was noted that bi-lateral programs between Japan and one EU-member country (e.g. Germany, France) exist, but that similar programs between Japan and the EU as a whole are almost absent.
- Establishing structural collaboration between EU-Japan can only be successful under certain conditions.

Despite above conditions not being met at this point in time, an 'Agreement between the European Community and the Government of Japan on Cooperation in Science and Technology' (but still needs to be ratified by European Parliament) was made. The agreement includes the 'Establishment of a Joint Committee on Scientific and Technological Cooperation' to

- exchange of information and views and S&T policy, addressing past present and future cooperation activities;
- review access to funding programming and projects;
- bearing in mind the principle of reciprocity (access to each other's R&D funding programs).

This agreement is only a start. At the moment there are no easily accessible joint programs in the field of IRT and there are no big breakthroughs to this end. On the long term under above conditions collaboration schemes could be established, although experience thought this will not happen easily.

## 5. Short summary of discussion during panel-session:

After the talk by Dr. Pascall, the panel-session started. The discussions mainly went on why structural (top-down) collaboration is not possible now, how we can collaborate (bottom-up) and on which topics collaboration could/should be done.

Examples of current collaboration are bottom-up organized research activities initiated from the research groups themselves. Some examples were given of projects including Japanese companies and European universities:

- Prof. Abbink and T.U.Delft had successful collaboration with Japan, starting from a student contract, moving towards a PhD. Being satisfied with the results the Japanese company (Nissan) pursued a continuation of the collaboration. The collaboration Is still ongoing at both parties satisfaction.
- Prof. Van der Kooij also collaborates with Japan, on continuously extending contracts. These were two bottom-up approaches with a Japanese company.
- It was generally perceived that collaboration between universities is more complicated as to when money comes from industry. Some sporadic FP7 projects do include Japanese partners. But hereto this Japanese partner should posses a unique expertise at world level. Recognized excellence might not be enough. Also, as medical care and well fare is concerned, collaboration could prove invaluable to come up with generally applicable and sound solutions even without being able to prove unique expertise.
- Some remarks were made on the importance of 'Europe' for Japan. Europe is obviously in competition with South-east Asia (mainly Korea and China) and U.S., where the latter two are probably of higher importance to Japan. It was noted that it could be interesting to look and learn from existing Japan-U.S. collaboration schemes. Note that in well fare and medical care Europe and Japan have a common adversary, namely Intuitive Surgical (which could end up like a Microsoft for surgical robotics)…
- Prof. Van Brussel argued that there is actually already a structured collaboration taking place between EU and Japan (and others), namely on 'Intelligent Manufacturing Systems' http://cordis.europa.eu/ims/. The simplest approach is to expand this type of collaboration and cover other relevant topics relating Welfare and Ageing.

  After this, some thoughts were shared on how to shape future collaboration, so that successful applications could be prepared:
- Prof. Bruyninckx emphasises on the cultural differences and the need to make machines that are designed/acceptable for/by different cultures.
- Prof. Luo believes that agreements between universities are the way to go. Where collaboration takes place on mutual research topics. Also Japan is very interested in the EU education system. Japan whishes to have standardized education system with the rest of the East-Asian countries. Since EU has lots of experience in standardizing the education systems of different countries it could be interesting to give advice on this matter.
- Prof. Okunishi comments that FP7 participation for Japanese universities is at present too hard. Most Japanese universities that do apply for the FP7 are usually rejected. The problems are administrative costs also. He is going to contact the minister for possible collaboration. Mr. Pascall argued that there are plenty of companies that are

active in the 'proposal writing business' that help shaping proposals for a moderate price and suggested that interested Japanese universities should contact such companies and invest some money.

- Dr. Pascall stressed that a critical mass is essential to justify structural collaboration. He also mentioned that Robotics or IRT in general is probably a topic that both Europe and Japan could support.

## 6. Conclusion

The workshop was concluded with great success. The outcome of this workshop can be summarized as follows:

- Participants obtained a better view on existing possibilities for collaboration on IRT subjects between EU and Japan. Basically, at present
  - through bi-lateral agreements between Japan and member countries (not discussed in detail) or
  - bottom-up, through initiatives between European research institutions and Japanese companies, or
  - sporadic EU funded projects where the Japanese partners possess a unique expertise in a topic that falls within EU funding scope;
  - more structurally organized (top-down) collaboration is at present not possible but required in the future.
- IRT for medical care and well fare seems an ideal field for collaboration, because
  - global solutions are needed taking into account cultural differences,
  - the topic is of interest of both EU and Japan who face imminent problems triggered by their ageing societies.