Workshop Digest

2022 IEEE/SICE International Symposium on System Integration

Workshop on Dependable Safety Systems
- ANSHIN & Safety for Robots & Intelligent Systems -

Online
January 9, 2022

Co-organized by
SICE/SI TC for Dependable Safety Systems
JSME/RMD TC for ANSHIN & Safety Robotics & Mechatronics
Forward

It would be our great pleasure to hold the second workshop on Safety & ANSHIN Systems co-organized by three different TCs from SICE/SI, JSME/RMD and IEEE/RAS. Safety is the most crucial issue for developing and applying various robots and intelligent systems nowadays. The service robot has a wide range of its application as shown in its definition and is expected to be applied in our society. The safety includes both physical safety and ANSHIN. The physical safety means a common sense of safety as suggested by safety engineering, industrial safety standard, etc. The physical safety will include issues on how to secure and keep safety, and how to recover from unsafe conditions in collapse, explosion, disaster, contamination, whatever dangerous. ANSHIN means psychological safety or mind safety, which includes various feelings and states of mind; familiarity, peace of mind, no stress, no anxiety, etc. The topic on AHSHIN comes to more important issue when we bring the service robots and systems to their actual market. How we feel toward service robot working in and around our daily life, how we evaluate our ANSHIN situation quantitatively are crucial as well as securing physical safety of robots and systems. We need to discuss both safeties in the aspects of what the state-of-the arts, what is the current issues, how we solve them. The workshop aims to discuss a wide range of safety issues on robots and systems. The workshop includes 2 keynotes, 1 invited and 3 technical speeches and open discussions. We hope this workshop could work and contribute to explore any idea and methodology to deal with various safety issues in robots and intelligent systems. Finally, we would appreciate the SII Committee members, all contributors and participants as well as all TC members for their supports and encouragements.

Workshop General Co-Chairs
Prof. Tatsuo Arai
Dr. Tamio Tanikawa
Prof. Kenichi Ohara
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SCHEDULE

January 9, 2022
Time Zone: Central European Time (UTC+1)

7:55-8:00 Opening
Tatsuo Arai, TC Chair, IEEE/RAS

8:00-8:40 Keynote Speech 1
Chair: Tamio Tanikawa, AIST, Japan
New Era of “Collaborative Safety” where Humans, Robots and Environments are Closely Connected — Introducing Vision Zero Mind-Set which Accelerates the Social Implementation of Collaborative Safety, and the Concept of Vision Zero Summit Japan 2022
Toshihiro Fujita, The Institute of Global Safety Promotion (IGSAP) / IDEC Corporation, Japan

8:40-10:10 Invited and Technical Speeches
Chair: Kenichi Ohara, Meijo University, Japan

8:40 Technical Speech 1
Robot-Acquired Privacy and Its Protection
Tatsuo Arai*1 and Hiroko Kamide*2
*1UEC, Japan / BIT, China, *2Nagoya University, Japan

9:00 Technical Speech 2
From Accident Preventative Safety to Productive Safety
Tamio Tanikawa, AIST, Japan

9:20 Technical Speech 3
Overview and Recent Development of SafeML to Support System Safety Design and Development
Yoshihiro Nakabo, AIST, Japan
9:40 Invited Speech
Development and Field Application of Remote Control, Automation and Autonomy in the Construction Field
Hiroshi Furuya, Obayashi Co., Ltd., Japan

10:10-10:50 Keynote Speech 2
Chair: Tatsuo Arai, UEC, Japan / BIT, China
How can Blockchain Technologies Foster Safety, Security and Privacy in Large-Scale Robotics and AI Applications?
Fabio Bonsignorio, Heron Robots, Italy

10:50- Discussion & Closing
Tamio Tanikawa, TC Chairs, SICE/SI & JSME/RMD
Keynote Speech 1

New Era of “Collaborative Safety” where Humans, Robots and Environments are Closely Connected


Toshihiro Fujita
The Institute of Global Safety Promotion (IGSAP) / IDEC Corporation, Japan

ABSTRACT
The world is now in the midst of the “Fourth Industrial Revolution,” with the advancement of IoT (Internet of Things), robotics, mobility, AI (Artificial Intelligence), etc. The concept of “Collaborative Safety” has sprouted as a new way of thinking about safety and anshin, and potential social needs are beginning to become apparent as a major global trend. In particular, Vision Zero, which places its importance on the wellbeing of workers, is beginning to emerge in terms of ESG and SDGs after Covid-19. Vision Zero is the global campaign to achieve safety, health and wellbeing for workers by taking a top-down approach, with over 15,000 companies and organizations currently participating. At the very core of this trend is the growing recognition of the need for Collaborative Safety, which is the main theme of the Vision Zero Summit Japan to be held in May 2022.

In my talk, I will introduce such trends, including the examples of specific company initiatives, and share with you the latest global OSH movements.
Dr. Toshihiro Fujita received B.S, M.S and Ph.D. degrees from Osaka University in 1977, 1980 and 1988, respectively. He joined the central research laboratory, Matsushita Electric Industrial Co. Ltd. (in present, Panasonic Corporation). From 1986 to 1987, he was a visiting fellow of the department of electrical engineering, Cornell University. In 1992, he moved to IDEC Corporation as the director of research and development. He was the senior executive officer for the research and development, marketing, and the technological strategy of the IDEC Corporation from 1998 to 2021. Since 2021, he is the senior executive officer, management of technologies, IDEC Corporation. In addition, since 2003, he is the chairman and representative director, Japan Certification Corporation.

He is Chair of Control Safety Committee of the Nippon Electric Control Equipment Industries Association (NECA), International Committee Member of IEC/SC121A/WG3 (Low-voltage switchgear and controlgear), Member of Technical Committee on Industrial Machinery of Japanese Industrial Standards Committee (JISC), Director of Japan Robot Association (JARA), Director of the Institute of Global Safety Promotion (IGSAP). Since 2020, he is a member of Global Coalition for safety and Health at Work, Task Group on Vision Zero at the Enterprise Level.

Dr. Fujita received Excellence Prize of the Monodzukuri Nippon Grand Award for Robot-Controlled Cell Production System ‘Assemble shop’ in 2005, Minister of Economy, Trade and Industry Award of Industrial Standardization Project Award in 2013, and the Japan Machinery Federation President Award of the 7th Japan Robot Award in 2016.
Technical Speech 1

Robot-Acquired Privacy and Its Protection

Tatsuo Arai*1 and Hiroko Kamide*2

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ABSTRACT
The Personal Information Protection Law in Japan came into effect in 2005, and with the progress of big data utilization, the revised Personal Information Protection Law was enacted in 2015. Our society as a whole has become sensitive to the handling of privacy information. In this aspect we need to pay much attention to handling the personal information that robots acquire appropriately in light of the law. If the information acquired by home-use service robots is not properly protected, there is a great risk that various personal information such as name, address, birth date, individual physical data, life style, preference, etc., will be leaked to others, even for office robots and industrial robots. In public robots, unauthorized use of public information may invade the interests and safety of society. If personal information is leaked, it will increase the risk of crimes and disadvantages such as persistent targeting, unjustified false accusations and exploitation, theft and DV re-damage. In this report, we examine the privacy information that can be acquired by four types of robots, and classify it by the following aspects; target user, operation mode, collectable information, information retention form, usage purposes and issues in privacy. The data retention forms are levelled according to the access from outside; a) robot internal data, b) user site network data and c) outside cloud data. Then we analyze the information security technologies to protect privacy data which are collected by robots. The risk of privacy information leakage has two cases, illegal access from outside to the retention forms a) b), and access from unspecified to the form c). In the former case the data should be protected by the information security technology. In the latter case the access from unspecified should be limited and the privacy data should be protected by the privacy protection technology. We survey some privacy protection methods; homomorphic encryption for data base query, de-anonymization, k-anonymity and differential privacy. Finally we discuss the relationship between privacy security and ANSHIN, psychological safety.
BIOGRAPHY
Professor Tatsuo ARAI received B.S. M.S. and PhD degrees from the University of Tokyo in 1975, 1977, and 1986, respectively. He joined the Mechanical Engineering Laboratory, AIST in 1977, and was engaged in research and development of new arm design and control, mobile robot, teleoperation, and micro robotics. He stayed at MIT as a visiting scientist in 1986-1987. He was an adjunct lecturer at Chiba University and gave a course on robotics. He moved to Osaka University in 1997 as a full professor at the Department of Systems Innovation, Graduate School of Engineering Science. In April 2017, he moved to School of Mechatronics, Beijing Institute of Technology. He is also a visiting professor at the University of Electro-Communications, Tokyo, and a professor emeritus of Osaka University, Japan. His current research topics are mechanism design including parallel mechanisms, legged working robot, micro robotics for bio and medical applications, human robot interaction. He has published more than 550 journals and reviewed conference papers on robotics, 5 English books, and has 37 patents including foreign 8. He is Corresponding Co-chair of IEEE/RAS TC for Energy, Environment and Safety Issues in Robotics and Automation, IAARC (International Association of Automation and Robotics in Construction) past Vice President, IEEE Life Fellow, JSME Fellow, RSJ Fellow, and SICE Fellow. He is a deputy editor-in-chief of the Robomech Journal. He worked for the Japanese Cabinet Office as a chair of the Technical Advisory Committee of the Destruction of Abandoned Chemical Weapon in 2000-2007. He was a project leader of JSPS National Project on Hyper Bio Assembler in 2011-2016.
Technical Speech 2

From Accident Preventative Safety to Productive Safety

Tamio Tanikawa
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ABSTRACT
In response to the decline in the working age population due to the declining birthrate and aging population, it is necessary to improve per capita productivity and increase the working age. This is an issue that any country will face in the future, and will have a major impact on all industries. One solution is the development of work support technology using AI and robots. On the other hand, it is difficult for AI to explain the recognition results, and a new concept of safety is required to use AI and robots and work more closely with humans.

Until now, based on the recognition that human behavior is unpredictable, the image of a predicted accident and the necessary safety measures have been discussed (Accident preventative Safety). In the future, in order for humans and robots to cooperate, technology to predict human behavior is required. That is, human modeling is important. By accurately modeling individual people, it is possible to predict human behavior using technologies such as AI. By using an accurate model of an individual, work support suitable for the individual is possible. This leads to improved productivity. In other words, improving safety enables individual human management and increases productivity. This is a new safety concept (Productive Safety).

Usually, safety is not directly linked to productivity. As a result, managers tend to neglect safety. However, in Productive Safety, we believe that improving human management can improve both safety and productivity. In the white paper, we believe it is important to propose a new safety concept that improves safety and improves productivity.
BIOGRAPHY
Dr. Tamio Tanikawa received M.S. degree from University of Tsukuba in 1993, and Ph.D. degree from Osaka University in 1998. He joined Mechanical Engineering Laboratory, Agency of Industrial Science and Technology (AIST) in 1993. He was at Intelligent Systems Research Institute (ISRI), National Institute of Advanced Industrial Science and Technology (AIST) from 2001. He had been seconded to Industrial Machinery Division, Manufacturing Industries Bureau, Ministry of Economy Trade and Industry (METI) for a year in 2003. He was Director, Research Planning Office, Department of Information Technology and Human Factors, AIST from 2015 to 2017. At present, he is Director, Industrial CPS Research Center, Department of Information Technology and Human Factors, AIST since 2020.

His current research topics are micro robotics for bio and medical applications, sensor network, social system design, and human-machine cooperative production systems. He was Division head of Robotics Mechatronics division, JSME in 2020. He is SICE Fellow, a board member of SICE for two years from 2014, and a visiting professor at Tokyo Metropolitan University.
Overview and Recent Development of SafeML to Support System Safety Design and Development

Yoshihiro Nakabo
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ABSTRACT
In order to design and develop safe systems, it is necessary to conduct safety analysis and risk assessment of the entire system, including the execution context of real environment, and to define safety requirements for development and testing of the robot system. This also requires the involvement of experts and engineers from various fields related to hardware, software, application, safety engineering, system engineering, UI, etc. The results of the analysis and test design information must be shared among these people and updated as progress is made in the design and development process.

One of the ways to meet such complex and difficult requirements is model-based design. SysML is a modeling language that can model hardware, software, and execution contexts, and we have extended its profile especially for safety analysis, safety requirements, and safety design to include the contents of international safety standards for machine safety such as ISO 12100. We have named it SafeML and have been promoting its practical use and extension development.

In this presentation, I will give an overview of the SafeML and describe the recent modeling efforts using SafeML in a WG of the Robot Revolution & Industrial IoT Initiative (RRI) which is a private-led organizational platform in Japan to promote spread use of various new types of robots.
BIOGRAPHY

Dr. Yoshihiro NAKABO received the BE, ME and Dr. Eng. degrees in Mathematical Engineering and Information Physics in 1995, 1997 and 2000, respectively, from the University of Tokyo, Tokyo, Japan. From 2000 to 2002 he was a research associate of a JSPS research project at the University of Tokyo. From 2002 to 2005 he was a research scientist of Bio-Mimetic Control Research Center at RIKEN. At present he is a team leader of Dependable Systems Research Team at Industrial Cyber-Physical Systems Research Center of the National Institute of Advanced Industrial Science and Technology (AIST).

His current research interests include safety and dependability of personal care robots and collaborative robots controlled by AI. He participates in the NEDO R&D Project - AI Quality Assurance with a research theme of the R&D of Quality Evaluation Index and Measurement Testbed for Machine Learning Systems.
Invited Speech

Development and Field Application of Remote Control, Automation and Autonomy in the Construction Field

Hiroshi Furuya
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ABSTRACT
Technology development related to robotization in the construction field has become active again in recent years, and proposals for various construction robots and development of automatic / autonomous driving technology for heavy machinery are becoming active. Among them, remote control of heavy machinery is the core technology of construction robots due to the needs for disaster recovery. In recent years, remote control using 5G communication has also been put into practical use, improving construction efficiency and continuing to evolve as a system that can also support SDGs. In addition, automation and autonomy are gradually being put into practical use, and a system for integrated management of machine and sensor information has been developed and some of them have been put into practical use. We will introduce the development status and outline of these.
BIOGRAPHY

Dr. Hiroshi Furuya graduated from Hokkaido University in 1983 and joined Obayashi Corporation, one of a major Japanese general contractor. While developing technology for civil engineering work and working on job site, he has developed a system that attaches GPS to heavy machinery and manages construction based on position information for the purpose of improving the quality of civil engineering earth work, especially soil compaction for road and dam construction. In 2001, he obtained a doctoral degree from Hokkaido University by developing a system that implements the quality of the above while performing construction using an acceleration sensor. He is really a geotechnical engineer and also has a qualification as a soil foundation engineer. He has been working at Obayashi Corporation’s Technical Research Institute since 2008, applying ICT to civil engineering work and developing management systems using databases, and since 2016 he has been involved in the development of construction robots. His control equipment and quality control method received the Technology Development Award from the Japan Society of Civil Engineers and the Dam Association. He is a member of the expert committee of the Ministry of Land, Infrastructure, Transport and Tourism, a visiting professor at Kumamoto University from 2014, a vice chairman of the Japanese Geotechnical Society for two years from 2015, a director of building SMART Japan from 2018, and regional information of the Ministry of Internal Affairs and Communications from 2019. He is also a board member of ISARC. He is still developing systems and software related to construction management at the Obayashi Technical Research Institute.
How can Blockchain Technologies Foster Safety, Security and Privacy in Large-Scale Robotics and AI Applications?

Fabio Bonsignorio
Heron Robots, Italy

ABSTRACT
The ongoing massive adoption of robots, AI applications and smart systems will ultimately lead to the spread of “smart cities” and “smart lands”. However, the creation of large scale heterogeneous, multi-vendor multi-agent networks of Cyber Physical Systems (CPS) is inevitably introducing new and fundamental challenges that the research community will have to address in the coming years. A giant number of connected devices lead to serious computing and communication infrastructures scalability challenges, more tight security requirements and privacy concerns. A main issue is that the data collected within CPSs contain critical or private data that need to be sufficiently protected against a variety of threats (e.g., errors or deliberate hacking, unwanted exploitation). Citizens and communities should be allowed to keep the ownership of their data. The autonomous AI and Robotic agents should be protected from hacking. Large-scale robotic and AI applications such as those envisioned by “smart cities” face serious challenges due to the system and network heterogeneity and multi-vendor environments. This raises the need of developing new security, compatibility, data-sharing, etc. standards as well as ensuring the scalability of the network. The problem of registration and monitoring of devices affects the public services and the respect of the rule of law. From a business perspective, the key issue is finding a way to create value from applications, and to this end it is necessary to guarantee coordination of both economic (market) and technical transactions.

The Blockchain, a public ledger whose information is protected by a consensus algorithm, and the new ‘future internet’ technologies based on decentralized peer-to-peer technologies known as Web 3.0, demonstrate the possibility to create large networks of robotic devices, AI agents and smart systems, and has the ability to solve those problems — including scalability issues — in massive complex multi-agent networks.

We will in particular discuss safety and cybersecurity issues, under different respects, including safety evaluation, cybersecurity implementation, privacy as well as robot application for safety.

The talk aims at providing an overview of novel ideas, challenges and possible solutions of practical and theoretical problems made possible by distributed ledger technologies.
BIOGRAPHY

Prof. Fabio Bonsignorio is CEO and Founder of Heron Robots (advanced robotic solutions), see www.heronrobots.com. He has the legal certification as professional industrial engineer. He has been a Visiting Professor at the Biorobotics Institute of the Scuola Superiore Sant’Anna in Pisa since 2014 until 2019. He has been professor in the Department of System Engineering and Automation of the University Carlos III of Madrid until 2014. In 2009 he was awarded the Santander Chair of Excellence in Robotics at the same university.

He has been working in the R&D departments of several major Italian and American companies, mainly in the applications of intelligent systems and technology transfer with coordination/management responsibilities for more than 20 years, in the production and logistics environments.

He is a Founding Director of euRobotics aisbl, the private part of SPARC, the Eu Robotics PPP. He has been a member of the Research Board of Directors of SPARC twice. He has been a board member of EURON III.

He coordinates and is the main teacher of the ShanghAI Lectures since 2013. The ShanghAI Lectures,(www.shanghailectures.org), are an advanced online teaching on Embodied AI, initiated several years ago by Rolf Pfeifer. His preferred research topics are in AI and advanced robotics: Industry 4.0, Precision Agriculture, Supply Chain management, cognition, control, modeling, software architectures, robot swarms, intelligent agents, epistemological issues in robotics, performance evaluation and foundational issues like ‘morphological computation’. He has pioneered and introduced the topic of Reproducible Research and Benchmarking in Robotics and AI, where is one of the leading experts, if not the leading one. He is a pioneer in the application of Blockchain technologies to robotics.

He is Reproducibility Editor of the IEEE Robotics and Automation Magazine.