

Plenary Session III, F2PS-III, Rm#601, 11:10-12:00 Friday, 20 December

## "The Next Technological Wave: Intelligence Technology ("IT") for Intelligence Super-Agent"

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Information technology (IT), first coined in 1958 and booming since the early 1990s, is the application of computers and telecommunication equipments to store, retrieve, transmit and manipulate data. In 1990s, the concept of Information Superhighway was developed to realize the goals of IT across the globe. In a business context, it has been defined as "the study, design, development, application, implementation, support or management of computer-based information systems" by the Information Technology Association of America. It has generated several associated industries, such as computer HW, SW, electronics, semiconductors, internet, telecom equipment, e-commerce and computer services.

Now we are facing a new technological challenge on how to store and retrieve knowledge and manipulate intelligence, in addition to the management of information and data, for autonomous services by intelligent systems. In this regard, the speaker has proposed "intelligence technology ("IT") for robots that think" in his recent paper in IEEE Computational Intelligence Magazine (August 2013). "IT" is the application of computers and machines to perceive and process data and information for knowledge-based reasoning and utilize their own reasoning to execute an appropriate action. "IT" covers all aspects of intelligence from perception at sensor level and reasoning at cognitive level to behavior planning at execution level for each low level segment of the machine. It is equipped with technologies for cognitive reasoning, social interaction with humans, behavior planning, ability to cooperate with other robots, ambience awareness, and an artificial genome that can be passed on to other robots. Based on these six aspects of intelligence technology, "IT" can be employed to build "Intelligence Super-Agent (iSA)." A virtual example for such an agent is VIKI (Virtual Interactive Kinetic Intelligence), an intelligent virtual super-agent from a science-fiction action film, I-Robot, released in 2004. iSA aims to augment human capabilities in perception, reasoning and actions as well as to provide intelligent supervision to lesser intelligent robots and devices within its domain

This talk presents the concept of iSA and Intelligence Operating Architecture (iOA) for realizing iSA using "IT." iOA, inspired by human brain functions, is a modular framework that can be used as a whole or in modules to generate intelligent functions for iSA. It can be used to implement different kinds of intelligence, such as cognitive intelligence, social intelligence, behavioural intelligence, ambient intelligence, collective intelligence and genetic intelligence. To emphasize the functionality of each category of intelligence, this talk also introduces the related research outcomes for building thinking robots, i.e. "Robots That Think," carried out at the Robot Intelligence Technology Lab., KAIST in recent years. These research outcomes include mechanisms of thought for robots, humanoid robot's ability to choose the gaze direction, evolutionary multi-objective optimization for humanoid robot navigation, etc. Moreover, DREAM (Development of Robots Enacted through user-level Agent-based Modularization) for realizing iSA and other intelligent robots through iOA are also presented. These outcomes shall pave the way to the development of iSA.

Related publications are available at [http://rit.kaist.ac.kr/home/International\\_Journal](http://rit.kaist.ac.kr/home/International_Journal).

### His biography

Jong-Hwan Kim received his B.S., M.S. and Ph.D. degrees in Electronics Engineering from Seoul National University, Korea, in 1981, 1983 and 1987, respectively. Since 1988, he has been with the Department of Electrical Engineering at KAIST and is currently KT Chair Professor. He was Head of Robotics Program, KAIST for 2004-2006. He is Adjunct Professor of Griffith University, Australia and Honorary Professor of De La Salle University, the Philippines. Dr. Kim is Director for the National Robotics Research Center for Robot Intelligence Technology. His research interests include computational intelligence and ubiquitous and genetic robotics. Dr. Kim has authored 5 books and 3 edited books, 2 journal special issues and around 300 refereed papers in technical journals and conference proceedings. He currently serves as an Associate Editor of the IEEE T. on Evolutionary Computation and the IEEE Computational Intelligence Magazine. Dr. Kim is one of the co-founders of the Int'l Conf. on Simulated Evolution and Learning in 1996, FIRA Robot World Congress in 2002 and Int'l Conf. on Robot Intelligence Technology and Applications (RITA) in 2012. He was General Chair for the IEEE Congress on Evolutionary Computation, Korea, 2001, the IEEE Int'l Symp. on Computational Intelligence in Robotics and Automation, Korea, 2009, and RITA 2012 and 2013. He has been on the program committees and advisory boards of more than 100 int'l conferences. Dr. Kim has delivered over 180 invited talks, keynote speeches and tutorials on computational intelligence and robotics in 24 countries. His name was included in the Barons 500 Leaders for the New Century in 2,000 as the Father of Robot Football. He is the Founder of FIRA and IROC and is currently serving them as President. Dr. Kim was the recipient of the science and technology award from the President of Republic of Korea in 1997 and has been elevated to 2009 IEEE Fellow.