Citation

For pioneering contributions in Computer Vision and Robot Vision Systems as well as in the development of the new field by these applications to the preservation, analysis and display of the cultural heritages

Dr. Katsushi Ikeuchi

Position and Organization :
Professor, Interfaculty Initiative in Information Studies,
The University of Tokyo

Doctorate : Ph.D. (The Univ. of Tokyo, 1978)

Date of Birth : May 29, 1949

Brief Biography :

1973 Graduated from Kyoto Univ. Dept. of Mechanical Engineering and Science
1975 M.S. in Information Engineering, The Univ. of Tokyo
1978 Ph.D. in Information Engineering, The Univ. of Tokyo
1978 Postdoctoral Fellow at the Computer Science and Artificial Intelligence Laboratory, MIT
1980 Research Officer at the former Ministry of International Trade and Industry's (MITI) Electrotechnical Laboratory (now National Institute of Advanced Industrial Science and Technology (AIST))
1982 Postdoctoral Fellow at the Computer Science and Artificial Intelligence Laboratory, MIT (as an external researcher of MITI)
1983 Principal Research Officer at the former MITI's Electrotechnical Laboratory (now AIST)
1986 Associate Research Professor/Research Professor at The Robotics Institute, Carnegie Mellon University
1996 Professor, Institute of Industrial Science/Interfaculty Initiative in Information Studies, The Univ. of Tokyo

Other:
Fellow of IEEE, IPSJ, IEICE, and RSJ
IAPR 2nd Vice-president, IEEE-RAS Ad-Com, IEEE-ITSC BOG
Distinguished Lecturer of IEEE-RAS,IEEE-SPS, IEEE-CS
General Chair of IEEE-IROS95,IEEE-ITSC99, IEEE-IV01, ITSW04
Program Chair of IEEE-CVPR96, IEEE-ICCV03, IEEE-ICRA09

Main Awards and Honors :

1990 David Marr Award
1991 IEEE-PAMI CVPR Outstanding Paper Award
1996 IEEE-RAS K.S. Fu Memorial Best Transaction Paper Award
1997, 2008 RSJ Best Paper Award
2000, 2004, 2005 VSMM Best Paper Award
2000 VRSJ Best Paper Award
2005, 2008 IPSJ Best Paper Award
2011 IEEE-RAS Most Active Distinguished Lecturer Award
2011 IEEE-PAMI Distinguished Researcher Award
2012 Medal with Purple Ribbon
2013 IEICE Achievement Award

Main Achievements :

Dr. Katsushi Ikeuchi conducts in-depth research into the fundamental theories of topics such as "shape-from-shading," based on research in the field of computer vision. This field of study aims to facilitate awareness and understanding of the external world by passing images through computers. At the same time, his work also involves developing applications for these fundamental theories to areas such as robot programming and the modeling of objects. In recent years, he has also harnessed these research results into efforts to create a research field that fuses the humanities and sciences. Known as "e-Heritage," this field seeks to preserve, utilize, and analyze cultural heritage through the computer. Three of his representative achievements are described in further detail below.

1) The proposal of "Smoothness constraint"

When human beings look at a picture, they can gain a sense of depth through its shading. The field of study that attempts to recreate this ability through computers is called "shape-from-shading." If we were to consider shape-of-shading from a mathematical perspective, obtaining the brightness of a certain point is equivalent to formulating an equation that contains two unknowns—brightness and gradient of the surface. The difficulty of the shape-of-shading problem lies in the indeterminate nature of this problem: when only the brightness value is obtained, the number of unknowns exceeds the number of equations. To tackle this problem, Dr. Ikeuchi was the first in the world to propose a new constraint that "a certain point has a similar gradient to the points around it," thereby resolving this indeterminate problem. He named this new constraint "smoothness constraint." Thereafter, the smoothness constraint was used in many forms of analysis, including motion analysis, and became one of the established methods of problem-solving in the field of computer vision. The original paper that laid out the concept of smoothness constraint for the first time in the world, and which was published in the ***International Journal of Artificial Intelligence***, was selected as "One of the Most Influential Papers in the Last Decade."

2) The proposal of learning robots that acquire action models by observing human behavior

Dr. Ikeuchi proposed the idea of robots that could acquire the necessary action models by observing human behavior. To construct this robot, he further proposed a framework of understanding called the "task model." He established categories for human behavior, and conducted studies to find out how task models could be grouped into order to facilitate understanding of the actions. The actions that could be adequately defined by the groups of task models included the assembly of two cubic objects, the assembly of polyhedrons, and the assembly of mechanical parts, lacing tasks, eating-related actions, and full body motions such as the Aizu-Bandaisan dance. In particular, the performance of the Aizu-Bandaisan dance by a humanoid was widely covered by the mass media, and had a significant influence on research of dancing robots at the National Institute of Advanced Industrial Science and Technology (AIST) and other institutions. Recently, these task model analyses have been used to categorize the dances of Taiwanese aboriginal dances, thereby strengthening the links between cultural anthropology and robot engineering. For these research achievements, Dr. Ikeuchi was commended with the IEEE-RAS K.S. Fu Memorial Best Transaction Paper Award, the RSJ Best Paper Award (twice), as well as the IEEE-RAS Most Active Distinguished Lecture award.

3) Creating the "e-Heritage," field for modeling cultural heritage

Tangible cultural heritage is constantly disappearing from our world, as evident in cases such as the destruction of the Buddhas of Bamiyan and the burning of Kinkaku-ji. Intangible cultural heritage is also confronted by similar risks, due to reasons such as lack of successors and ethnic cleansing. Active steps are being taken to promote the preservation of such tangible and intangible cultural heritage through computer vision technology. Technological development to further this aim includes geometric information processing for recording the shapes of tangible cultural heritage, the development of color information processing technology, and as described earlier, the derivation of task models for recreating human dances through robots.

On top of these, the technologies developed have also been applied to creating actual contents for the Buddha statues in Nara and Kamakura, decorated tombs in Kyushu, and the Angkor Wat ruins in Cambodia. These contents have appeared in the opening scenes of NHK ***Taiga*** dramas, history textbook illustrations in junior and senior high schools, and served as exhibits at the Tokyo National Museum and Kyushu National Museum. Furthermore, not only has the data been used to create contents; by analyzing the data obtained using computers, it has become possible to gain new archeological and ethnological knowledge through a system named "e-Heritage." For these achievements, Dr. Ikeuchi received the Best Paper Award at the VSMM on three occasions, as well as the IEICE Achievement Award.

As described above, Dr. Ikeuchi is engaged in pioneering research on computer vision and robot vision in the field of information and communication technology, and applied these technologies to the creation of the unique field of "e-Heritage," which seeks to preserve, utilize, and analyze cultural heritage. He has also contributed to producing a large pool of human resources in the aspect of personnel development, and to the development of university programs. The Okawa Prize is hereby presented to Dr. Ikeuchi on this occasion in commendation of his achievements and significant contribution to society.