

## Citation

For pioneering contributions to and leadership in the field of computer-based speech recognition and understanding



## Dr. Sadaoki Furui

## Positions and Organizations :

Professor Emeritus,  
Professor, Academy for Global Leadership,  
Director, University Contents Utilization Center,  
Tokyo Institute of Technology (Tokyo Tech)

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

Date of Birth : September 9, 1945

## Brief Biography :

1968 B.S., in Mathematical Engineering and Instrumentation Physics,  
The Univ. of Tokyo  
1970 M.S., The Univ. of Tokyo  
1970 Researcher in the Electrical Communications Labs. of Nippon  
Telegraph and Telephone (NTT) Corporation  
1978-1979 Visiting researcher, Bell Labs.  
1986 Head of Section No. 4, NTT Basic Research Labs.  
1989 Director of Speech and Acoustics Lab., NTT Human  
Interface Labs.  
1991 Director of Furui Research Lab., NTT Human Interface Labs.  
1997 Prof., Dept. of Computer Science, Graduate School of Information  
Science and Engineering, Tokyo Tech  
2007 Dean of the Graduate School of Information Science and  
Engineering, Tokyo Tech  
2009 Director, Tokyo Tech Library and Tokyo Tech Archive Initiative  
2011 Prof., Emeritus and Institute Prof., Tokyo Tech  
2012 Prof., Emeritus and Prof., Tokyo Tech

## Other:

Fellow of IEEE, ASA (Acoustical Society of America),  
ISCA (International Speech Communication Association),  
Institute of Electronics, Information and Communication  
Engineers of Japan (IEICE)  
President of ISCA, APSIPA (Asia-Pacific Signal and Information  
Processing Association), and Acoustical Society of Japan (ASJ)  
Collaborative Member, Science Council of Japan

## Main Awards and Honors :

1985 and 1987 ASJ Sato Paper Award  
1988, 1993, and 2003 IEICE Best Paper Award  
1989 Minister of Science and Technology Achievement Award  
1989 IEEE Acoustics, Speech and Signal Processing Society Senior  
Award (Best Paper Award)  
1991 IEICE Best Book Award  
1993 IEEE Signal Processing Society Distinguished Lecturer  
2003 IEICE Achievement Award  
2006 Minister of Education, Culture, Sports, Science and Technology  
Commendation for Science and Technology  
2006 IEEE Signal Processing Society Award  
2006 Purple Ribbon Medal of Honor  
2008 IEICE Distinguished Achievement and Contributions Award  
2009 ISCA Medal for Scientific Achievement  
2010 IEEE James L. Flanagan Speech and Audio Processing Award  
2012 NHK Broadcasting Culture Award

## Main Achievements :

Dr. Sadaoki Furui over the course of his long career has been engaged in research at the international level on speech information processing, in particular computer-based speech recognition and understanding. He has proposed fundamental technologies in this area and contributed to the advance of the technology while also helping to educate numerous researchers.

Among the major fruits of his research, he revealed the important role of speech dynamic features in human speech perception, and proposed a method of speech recognition that analyzes those dynamic features in the speech signal spectrum by obtaining regression coefficients from the cepstral time series (dynamic cepstrum) and then combining instantaneous and dynamic cepstrum parameters. This method led to major improvements in recognition performance, nearly halving the number of errors in spoken

word recognition. Today this approach is adopted in most of the speech recognition systems (products) in the world. In addition, noting that voice differences among speakers and speech variability due to background noise are important factors diminishing speech recognition performance, he confirmed experimentally the extremely high adaptability of human hearing and proposed various fundamental techniques for bringing such adaptation capability to computers.

The dynamic cepstrum is also a key parameter in speech synthesis using a hidden Markov model (HMM) for parameter generation, a subject of worldwide research in recent years.

Recognizing the problems of studying speech recognition and understanding based on voices reading a written text, he noted the importance of studies for developing speech recognition technologies applicable to naturally spoken language. In order to advance research in this area, he led a project, funded by the Minister of Education, Culture, Sports, Science and Technology Special Coordination Funds for Promoting Science and Technology, toward the realization of Spontaneous Speech Engineering. This project compiled Corpus of Spontaneous Japanese (CSJ), the world's largest and most accurate database of spontaneous speech, consisting of 7 million words. Based on this database, the project developed phoneme and language models and speech recognition methods. As a result, recognition accuracy of spontaneous speech, which up to that time had proven extremely difficult, was greatly improved. Moreover, the project proposed automatic speech summarization technology, for extracting from speech recognition results the most important sentences based on the information weight (significance) of words, reliability, and grammatical and semantic correctness, and then automatically compressing each sentence. The CSJ as a standard speech corpus has been put to wide use by researchers and engineers in Japan and abroad in creating acoustic and language models for various speech recognition and understanding systems, with more than 1,000 academic papers published to date making use of this corpus.

As Tokyo Institute of Technology Leader of the five-year 21st Century Center of Excellence (COE) Program "Framework for Systematization and Application of Large-scale Knowledge Resources," he helped to promote interdisciplinary research combining humanities and technology on the compilation and utilization of large-scale knowledge resources in electronic forms, leading to numerous achievements.

In the area of applications, he served as leader of the METI project "Development of Fundamental Speech Recognition Technology" carried out jointly by two universities and four companies. This project achieved a number of results including development of the T<sup>3</sup> decoder, a high-performance and flexible speech recognition engine operating on WFST (weighted finite state transducers). Made available as open source, the T<sup>3</sup> decoder is used by many research institutions in Japan and overseas. He has also contributed to the development of NHK's automatic closed captioning system for broadcast speech.

In recognition of these and many other accomplishments, Dr. Furui has received numerous awards in Japan including the Purple Ribbon Medal of Honor presented by the Emperor of Japan, the Minister of Education, Culture, Sports, Science and Technology Commendation for Science and Technology, and the NHK Broadcasting Culture Award, as well as some of the top international awards in speech information processing such as the ISCA Medal and IEEE Flanagan Award. He has also served as President, Director, Editor and in other positions in academic institutions in Japan and abroad, contributing to international academic activities.

Both at the NTT Laboratories and at the Tokyo Institute of Technology, he has educated researchers and students from around 30 countries, many of whom have gone on to be active throughout the world as teachers, researchers, and engineers in multimedia information processing including speech. He has also visited around 40 countries to give technical presentations, lectures, and technical instruction or take part in joint research, and has been selected as Distinguished Lecturer by the IEEE and ISCA. Dr. Furui's book *Digital Speech Processing, Synthesis, and Recognition* (1989, latest edition published in 2001 by Marcel Dekker) is widely regarded internationally as an introduction to speech information processing for young researchers.

For pioneering contributions to and leadership in the field of computer-based speech recognition and understanding, both in Japan and internationally, Dr. Sadaoki Furui is hereby awarded the Okawa Prize.