Satoshi Nakamura
Nara Institute of Science and Technology

Bridging different languages, countries, and cultures by Speech-to-speech Translation Research
Speech-to-speech translation technology has been one of the human dreams, which breaks language barrier between different language speaking people. In 1986 Japanese government launched the first national project on speech-to-speech translation at *Advanced Telecommunications Research Institute International, ATR* in Kyoto, Japan. There were four big projects on speech-to-speech translation, human visual and auditory information processing, virtual reality, and communications technologies. The *ATR* project attracted and invited many outstanding international researchers from the world. Dr. Alex Waibel was one of the brightest young researchers, who joined the speech-to-speech translation project in 1988, and played a very important role. The research target of the ATR project was to develop a speech-to-speech translation system for tourism. For the speech recognition various researches including HMM, spectrogram reading, and artificial neural network approaches were investigated. Especially the artificial neural network was very popular at ATR around 1988. Dr. Waibel invented the Time Delay Neural Network with ATR colleagues and Prof. Hinton, and later received an I*EEE paper award* for this invention. Now this convolutional multi-layer neural network became more popular by spreading as convolutional neural network. In 1992 C-STAR, *Consortium for Speech Translation Advanced Research* was established with *ATR*, *CMU* and *KIT*. In 2004 C-STAR core partners launched *IWSLT, International Workshop on Spoken Language Translation* in order to promote the worlds' speech translation researches, which has performance competition track in addition to the normal scientific paper track. In 2009 the speech translation research team of *ATR* moved to *NICT, National Institute of Information and Communications Technology*, Japan. Then, *NICT* became a member of *InterACT* in 2010. I further moved from *NICT* to *NAIST*, *Nara Institute of Science and Technology* in 2011. *NAIST* became a member of *InterACT* in 2011. The important point of the speech-to-speech translation research is that the technology does not only bridge people who speak a different language but also connect people living in different countries, cultures, and technologies. Its research and development require very strong international collaborations as well as research collaborations in the field of speech and language processing. In my talk I would like to introduce those histories and new challenges toward a

multi-modal simultaneous incremental speech-to-speech translation. In addition, I would also like to introduce *GCP, Global Communication Project* in Japan. There will be an Olympic and Paralympic Games in Tokyo in 2020. Japanese government now launched the GCP with many industries and NICT to develop speech-to-speech translation services for incoming tourists.

Satoshi Nakamura is Professor of *Graduate School of Information Science, Nara Institute of Science and Technology,* Japan, Honorarprofessor of *Karlsruhe Institute of Technology*, Germany, and *ATR Fellow*. He received his B.S. from *Kyoto Institute of Technology* in 1981 and Ph.D. from *Kyoto University* in 1992. He was Associate Professor of *Graduate School of Information Science* at *Nara Institute of Science and Technology* in 1994-2000. He was Director of *ATR Spoken Language Communication Research Laboratories* in 2000-2008 and Vice President of *ATR* in 2007-2008. He was Director General of *Keihanna Research Laboratories* and the Executive Director of *Knowledge Creating Communication Research Center, National Institute of Information and Communications Technology*, Japan in 2009-2010. He is currently Director of *Augmented Human Communication Laboratory* and Professor of *Graduate School of Information Science at Nara Institute of Science and Technology*. He is interested in modeling and systems of speech-to-speech translation and speech recognition. He is one of the leaders of speech-to-speech translation research and has been serving for various speech-to-speech translation research projects in the world including *C-STAR, IWSLT* and *A-STAR*. He received *Yamashita Research Award, Kiyasu Award* from the *Information Processing Society* of Japan, T*elecom System Award, AAMT Nagao Award, Docomo Mobile Science Award* in 2007, and *ASJ Award for Distinguished Achievements* in Acoustics. He received the Commendation for Science and Technology by the Minister of Education, Science and Technology, and the Commendation for Science and Technology by the Minister of Internal Affair and Communications. He also received *LREC Antonio Zampoli Award* 2012. He has been Elected Board Member of *International Speech Communication Association, ISCA,* since June 2011, *IEEE Signal Processing Magazine Editorial Board Member* since April 2012, *IEEE SPS Speech and Language Technical Committee Member* since 2013, and *IEEE* Fellow since 2016.