Acoustic Echo Cancellers

Acoustic technology has evolved along with the development of telephones and audio devices starting from their inventions – the telephone in 1876 by Bell and the phonograph in 1877 by Edison.

The major turn-around point was the introduction of digital signal processing technology. Sound digitalization made it possible to do the convolution operation/ Fourier transformation on a real-time basis, and consequently, various applications were put to practical use. In the latter half of the 1980s, the acoustic echo canceller successfully made significant improvements to telephone speech quality, thereby serving as an impetus for widespread audio conferences and TV conferences. The principle was proposed in the 1960s by the Bell Laboratory in the United States. However, studies about adaptable algorithms and double-talk control technology were necessary for its practical implementation. In Japan, S. Makino, et al., proposed the index fade-out step size parameter and this contributed to the development of the acoustic echo canceller.

In the 1990s, audio digital processing was applied to active noise control which controlled noises by antiphase sounds. Currently, these are used for noise control in concert halls and the control of vehicle interior noises.

In addition, for the purpose of reverberation rejection and sound source separation, acoustic array processing technology as typified by the microphone array and the speaker array have also been studied. Regarding the study of sound source separation, research based on statistical signal processing and machine learning, e.g., independent component analysis, positive semidefinite matrix factorization, deep learning in addition to linear processing, have been advancing even today. Meanwhile, regarding sound reproduction, wavefront synthesis technology and ambisonics which are based on physical audio have come under the spotlight. Consequently, studies aimed at the natural recording/transmission of sounds that makes you feel as if you were actually listening to or having a face-to-face conversation have been carried out even today.

Delta/Sigma Modulation

In 1961, delta/sigma modulation was proposed by Y. Yasuda as one type of communication method. From the very beginning, it was considered that it offered desirable properties for A-D transducers such as high accuracy, high stability and a constant dynamic range regardless of input signal frequency. Later, with the support of developments in digital signal processing technology and LSI technology, research and development into this method have become active more and more all over the world. Consequently, it is now definitely at the mainstream of the A-D transformation method.

Neural Circuit Networks which realize Intellectual Study

Neural networks are learning machines obtained through the combination of multi-layer neural circuit networks, called neocognitron proposed by K. Fukushima and the probabilistic descent learning method proposed by S. Amari. Recent remarkable performance improvements in image recognition by deep learning would have been unthinkable without these basic concepts.