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A Melting Pot

When I was learning history in high school, I was taught that China is a melting pot. Along the course of Chinese history, Chinese dynasties have come and gone with many conquests by tribes of different cultures and ethnic backgrounds. The latest example is the Ching Dynasty. After hundreds of years of rule, it collapsed, ultimately leaving no trace of the people and culture from such a tribe. Once again in history, a conqueror quietly mingled into the melting pot of China.

In essence, signal processing as a technical field is also a melting pot. Signal processing finds its humble roots in the IRE Professional Group on Audio—which was the first IEEE Society established in 1948 (that's why you see 001 for the IEEE Signal Processing Society (SPS) when you renew your membership). The focus then was the analog design of audio speaker interfacing with acoustics, circuits, and magnetics. It was renamed the IEEE Group on Audio and Electroacoustics in 1966.

The 1960s marked the digital revolution period for signal processing. The early computers stimulated the design of sampled data filters in Bell Labs and the invention of fast Fourier transform (FFT) at IBM. In his historical perspective presentation, Past President Mos Kaveh pointed out that the FFT was especially embraced by this community to engage in digital spectrum analysis and filter design, as supported by more infusing of tools in statistics and mathematics. This sparked the era of digital signal processing with the landmark book, *Digital Signal Processing* by Gold and Rader (1969).

We saw in the 1970s the explosion of applications beyond speech and audio into digital communications, underwater acoustics, sonar and radar, geophysics for oil and mineral exploration, image processing, and pattern recognition, among others. The ideas of systems, controls, and learning theories for adaptive methods started to blossom. The IEEE Group on Audio and Electroacoustics became the IEEE Acoustics, Speech, and Signal Processing Society (ASSP Society) in 1976.

By the 1980s, statistical signal processing had become an integrated and important branch of signal processing with a significant impact on array processing and statistical speech recognition. Developing fast algorithms due to limited computing power was a major thread of research. Then came the era of very-large-scale integration (VLSI) technology that gave birth to digital signal processor (DSP) chips and application-specific integrated circuits (ASICs) for real-time signal processing.

It was in the mid-1980s when I came to the United States for my graduate studies. I was told that the United States was a melting pot where people from all over the world with different cultural and ethnic backgrounds came and settled together, and it was through this melting pot that these immigrants assimilated to U.S. life and became Americans. As a new graduate student who was unsure of which research area to focus, I came across a fascinating book called *VLSI Signal Processing*. The book's cover depicted a bridge connecting VLSI and signal processing for this newly emerging frontier. That was how I got into the business of signal processing.

I have been a witness to the developing story ever since. I have seen the development of speech, audio, image, and video compression standards from JPEG, MP3, to MPEG 1, 2, 4, and 7 in the 1990s. The rise of wireless revolution from the mid-1990s redefined signaling, modulation, and coding so much so that we can no longer identify a clear boundary between signal processing and communications. Smart phones and broadband wireless allow us to be in touch and online anywhere and at any time. The Internet, available from the new millennium, also brings the world closer together by democratizing cyberspace so that we can share movies, download digital music, tweet and upload compressed video/audio, and talk over Skype with free voice over IP from all over the world. (Isn't it true that signal processing played a role in facilitating the Arab awakening?)

In past decades, we saw the dramatic influence of new ideas from other areas that we could never have imagined before. We started the new journal *IEEE Transactions on Information Forensics and Security* in 2006. I would bet no one could imagine that the words "forensics" and "security" would appear as the norm in signal processing publications. The word "language" was added to the title of one of our journals now known as *IEEE Transactions on Audio, Speech, and Language Processing*. We also have the IEEE Workshop on Genomic Signal Processing to address the need of the advances of computational biology. The 2010 IEEE Thematic Workshop on Signal Processing, known as THEMES, focused on social networking. The evolutionary path of signal processing has been so inclusive that the boundaries of disciplines are constantly being pushed, and in some cases, melting away.

Today, we are facing more challenges in health care, energy, and the environment that call for signal processing to be infused with more interdisciplinary aspects of physical, biomedical, and social sciences. Soon those new terminologies will be part of signal processing. Isn't it so that signal processing is a melting pot?

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