NOISE reductions

Cancelling out unwanted background noise in digital communications

About two decades ago, an electrical engineer formulated an algorithm that allowed her to cancel out unwanted noise in audio transmissions. Today, the technology she explored is almost ubiquitous—found in mobile phones, headsets, wearable devices, and car and home applications. In fact, the interview for this story was conducted while she was talking on her phone in a car using the technology.

It began in 1997 when Gail Erten, founder of IC Tech, a small start-up in Michigan, made a cassette tape to use as a demonstration for possible investors. One recording on the tape had a music background and speech as input, both equally loud. Another documented the output after being subjected to her software—almost pure speech.

Funded by a Phase I Small Business Innovation Research (SBIR) contract, Erten had demonstrated, for the first time, that background noise could be digitally removed in real time.

"If I didn't have the SBIR, I would have had nothing to show the investors," Erten said. "What the SBIR allowed me to do was to find an implementation of a mathematical set of formulas to make it run in real time using real input—so that I could have a real-world demonstration that would pique the interest of investors."

At the time, the funding agency, the Ballistic Missile Defense Organization (now the Missile Defense Agency [MDA]) encouraged public–private partnerships in funding. Erten was able to interest an angel investor with her tape demonstration and secured a Fast Track Phase II SBIR to develop her software algorithm into a working technology.

The original SBIR topic was aimed at distinguishing signals of interest in the military domain—for example, determining through an electronic signal emanating from a missile if it was a real missile or a decoy. However, it became clear that there was a path to rapid commercialization with speech signal processing, and IC Tech's investors spun the company's commercial development off to a new company, Clarity (Erten became chief technology officer).

Another technology played a role in Clarity's growth. Voice command technology was being developed and noise cancellation was needed for voice commands to work. Clarity received more than $24 million in investment capital over a period of seven years.

Erten's initial research involved two microphones (input streams) for gathering and then extracting speech from the other sounds. Equations to do so were present in the literature at the time, she says, but no one had translated the equations to real-time software for the end user.

However, potential customers were looking for the same technology with a single microphone. "We listened to that and looked at other ways of solving the problem," she says. "Agility was a big contributor to our success." Clarity achieved clear voice capture (CVC) in addition to echo and noise cancellation with one microphone—the first company to do so.

Erten explains that in developing the new single microphone solution her team took advantage of the fact that speech goes through certain sequences of frequencies that are much more structured than noise. They explored signals recorded in a frequency domain and analyzed the frequency content, then set certain parameters in an algorithm that allowed them to separate speech from noise.

Erten's team at Clarity grew to fifty people, who developed a series of software modules for multiple digital signal processors for several customers.

In 2005 Clarity was acquired by Cambridge Silicon Radio (CSR), which produced platform solutions for Bluetooth, GPS, Wi-Fi, ARM processors and other mediums that were used in headsets, mobile phones, personal computers, and other devices.

Qualcomm Technologies acquired CSR in 2015 and markets cVc™ noise cancellation technology that stems from the Clarity team's original software. Many of the team members who worked with Erten are still in the same location and working for Qualcomm today.

Gail Erten

A CVC pioneer, Erten is humble about her success, saying someone else would have done it if she hadn't. She noted, "Most of my pride in this comes from the fact that I was successful in creating lasting jobs in the Rust Belt. These are good-paying high-tech jobs—and the region could use more of them."

She credited the SBIR award as being pivotal in the realization of her noise cancellation software, saying that if she had sought $200,000 to implement her idea in the early stages of funding investors likely would have told her to go away. "But SBIR didn't do that," she said. "They said, 'Okay, let's try it out.' Low and behold, it worked. I made a cassette. I had a proof in my hand—something a lot more tangible than a set of math equations."

Douglas Deason, director of Advanced Research at MDA today, says, "It's nice to see a company like this being so highly successful in developing a technology that's become so widespread today."

He reports that MDA's focus shifted away from partnering with the private sector in 2009 to support programs key to the U.S. defense mission, such as Terminal High Altitude Aerial Defense (THAAD) and the Ground-Based Interceptor. "We're really focused on supporting the war fighter—providing protection against a ballistic missile attack—especially today with the saber rattling going on out of North Korea," he says.

Deason reports MDA also takes a different approach to SBIRs than other branches of the military, by defining particular topics to be researched and opening up the process to whoever wants to apply; up to four companies are awarded contracts for each topic. That said, he notes that MDA "likes to see people that grow and have a commercial business as well, based on a weapon system need we've identified."

I.C. Tech, Inc. (Qualcomm)
Modernization Priority: General Warfighting Requirements (GWR)
Okemos, MI (San Diego, CA) • SBIR contract: F33615-97-C-1118 • Agency: MDA Topic: BMDO97-010, Adaptive Signal Conditioning and Calibration for Microelectromechanical System

The content in this article does not constitute or imply endorsement by the Department of Defense or the Military Service(s) of the provider or producer of the technology, product, process, or services mentioned.