



Welcome to the third issue of *Sound Innovation*, a quarterly newsletter created by Akustica to keep you abreast of technology advancements that can help you deliver the voice improvements demanded by your customers for your products. Each quarter, we will explore the timeliest topics affecting voice communications and provide you with access to leading-edge information that will help you understand emerging trends and evaluate new offerings.

EMBEDDED DIGITAL MICROPHONE ARRAYS FOR LAPTOP PCs

The previous issue of *Sound Innovation* focused on the benefits of using multi-microphone solutions to improve voice quality in consumer electronic devices. The challenges often faced by the designer when implementing a multi-microphone system were discussed and some potential solutions for overcoming those challenges were presented.

This issue is focused specifically on the laptop PC market and the implementation of digital-microphone arrays. In particular, we will explore how using digital microphones can overcome the typical acoustic and implementation challenges and enable the highest voice quality solution.

Embedded microphone arrays in laptop PCs are being driven by the need for improved voice input quality to support applications such as VoIP and speech recognition. While it is generally recognized that (multiple-) microphone arrays in conjunction with beamforming, noise suppression, and echo cancellation algorithms will produce a higher quality voice input, platform designers have often faced the following challenges when trying to implement an embedded array.

- RF/EM interference
- Microphone size
- Mechanical noise
- Speaker echo

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AKUSTICA NEWS

- Akustica Works to Solve PC VoIP Voice-Quality
- SigmaTel Introduces New High-Fidelity, High-Definition Audio Solutions for Notebook PCs
- *Sound Innovation* No.2 - Multi-microphone Solutions for Improving Voice Quality

INDUSTRY NEWS

- Microsoft's Gates Wants PCs To Learn To Listen
- Google to Launch Messaging, Voice Service
- Yahoo Looks to Boost Voice Services.
- People with Home Offices Want Laptop.
- Future Intel PCs May Include VoIP, Cellular
- VoIP is Killing Traditional Telephony

INDUSTRY EVENTS

- **MIPI Technical Meeting**
September 19-22
- **MEMS Executive Congress**
September 20
- **METRIC 2005**
September 21-22
- **CEATEC Japan**
October 4-8

[➔ Click here to meet with Akustica at any of these events](#)

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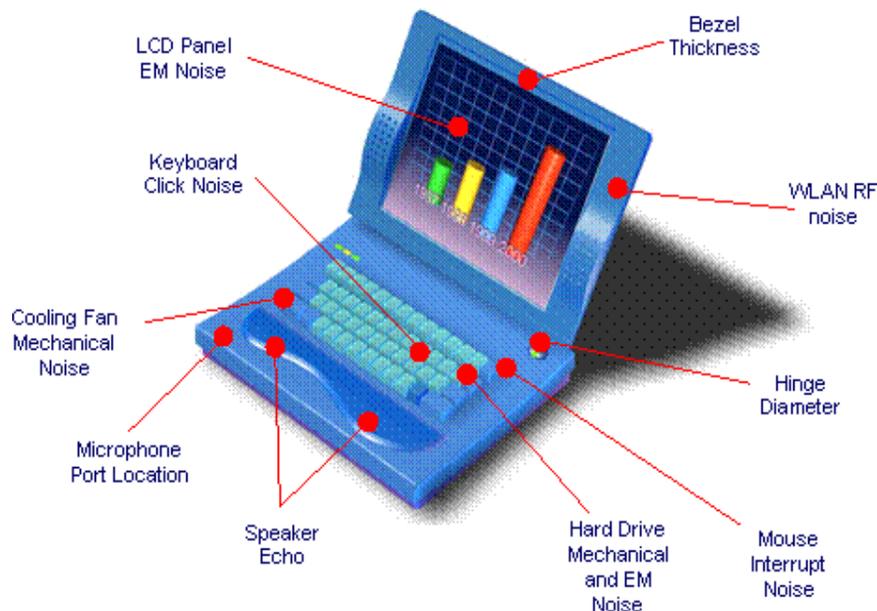


EMBEDDED DIGITAL MICROPHONE ARRAYS FOR LAPTOP PCs

By Dr. Marcie Weinstein, Director of Product Marketing

Embedded microphone arrays in laptop PCs are being driven by the need for improved voice input quality to support applications such as VoIP and speech recognition. While it is generally recognized that microphone arrays in conjunction with beamforming, noise suppression, and echo cancellation algorithms will produce a higher quality voice input, platform designers have often faced significant challenges when trying to implement an embedded array.

The challenges faced today trying to implement an embedded microphone array are shown and described in detail below:



- **RF/EM interference:** The display bezel is the optimal acoustic location for the microphone array as it is directly in-line with the mouth of the speaker sitting in front of the laptop. However, RF and EM noise generated by WLAN antennas in the bezel and by the LCD panel itself make this a hostile environment for a standard microphone.
- **Shielded cabling** is typically used to overcome RF/EM interference. Unfortunately, shielded cabling can be bulky and when used to route the signals from one or more microphones, can be too thick to fit through the hinge of the laptop to the base.
- **Microphone Size:** Standard electret condenser microphones (ECMs) can require 3-4mm of available bezel height due to microphone height and socket. This height is simply not available in many of today's ultra-light laptops.
- **Mechanical noise:** Hard drives, keyboards, and fans are just some of the ambient noise sources that can reduce the performance of a microphone array when it is located in the base.



- **Speaker Echo:** When the microphone port is in the base of the laptop, it is typically in close proximity to the speaker port and is therefore highly susceptible to acoustic echo.
- **Microphone Matching:** Typical microphones exhibit a wide variation in sensitivity and phase from part to part. The greater the variability between the microphones in the array, the poorer the performance of some algorithms.

All of the above challenges can be overcome with next generation microphones. For example:

- **Digital-output microphones** are immune to RF and EM interference sources in the monitor bezel. This eliminates the need to use shielded cabling which in turn allows the microphone array to be mounted in the bezel without concern for the hinge pin.
- **MEMS (MicroElectroMechanical Systems) digital-output microphones** enable microphone array integration into even the thinnest laptop bezels. These small surface mountable devices typically require less than 2mm of active height in the bezel since no socket is required. They can also be mounted directly to a board already in the bezel (such as antenna or camera modules) without concern for RF interference.
- **Single-chip MEMS digital-output microphones** can provide the highest quality microphone array performance due to their superior sensitivity and phase matching that is inherent to their semiconductor manufacturing process. The low part-to-part variability enables the highest performance of the noise suppression and beamforming algorithms. These MEMS microphones are also the least susceptible to RF interference due to the small distance between the transducer and the analog-to-digital converter.



AKU2000 Digital MEMS Microphone - bare die on PC keyboard

More detailed information on how to design an embedded digital microphone array can be found in a new Akustica White Paper. This white paper provides guidelines for the mechanical, electrical, and acoustical design of the array.

➔ [Click here to request a digital microphone array design guide from Akustica](#)



For more information from Microsoft on next generation operating system support for embedded microphone arrays, click on the link below:

■ **Microphone Array Support in the Next Generation Windows Operating System**
Microsoft Research

- [Microphone Array Support in Windows Vista ...](#)
- [WinHEC 2005 Powerpoint Presentation ...](#)

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