Hearing Implant Research

using the WaveBook™

Biomedical

Application Note #36

Just a few years ago, hearing aid technology offered little hope for the profoundly deaf. But now, a biomedical company produces an electronic cochlear implant that bypasses the eardrum and connects directly to nerves in the ear, enabling a profoundly deaf person to hear well enough to discriminate words.

Application Summary

Hearing aids and other types of assistive listening devices amplify sounds so that people with mild to moderate hearing loss can hear better. However, for individuals who are profoundly deaf, even the most powerful hearing aids provide very little, if any, benefit. This is because a profoundly deaf ear typically has damaged or diminished sensory receptors that cannot respond to sound regardless of how loud it is.

A biomedical company set out to develop a cochlear implant to bypass damaged receptors and directly stimulate hearing nerves with electrical current. This device would allow individuals with less than 10 percent word discrimination to experience a significant improvement in hearing.

The cochlear implant involves attaching a microphone to the ear. The microphone picks up audible sounds and sends them to a speech processor that digitizes the sounds using a digital signal processing (DSP) chip inside the ear.

The digitized signal is then transmitted through a wire to a receiver that modifies the digitized signal so that it can be passed on directly to neural tissue. Because every patient's neural tissue is different, each speech processor is programmed for unique processing characteristics during an implant programming session.

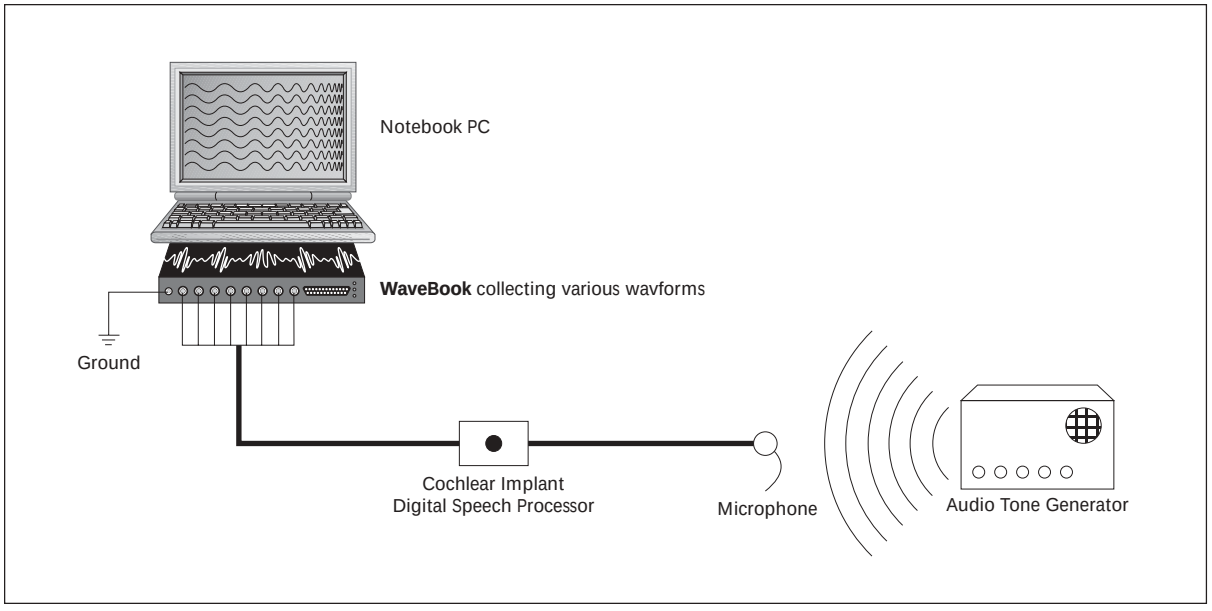
During implant programming, an audiologist takes psychophysical measurements and programs the speech processor with the specialized software. Guided by the software and patient's responses, the operator makes adjustments to the processor's thresholds and sets comfortable sound levels.

Development Challenges

Creating the implant's programming software presented a challenge to the biomedical company's engineering team, as the engineers needed a method of collecting numerous waveforms from the implant's stimulator so that critical sound data could be integrated into the software.

Potential Solution

Initially, the researchers attempted to collect waveforms with a digital storage oscilloscope. But the instrument's low channel count and slow speed hindered the team's efforts. In search of a more efficient method of collecting the waveforms, the researchers turned to a portable PC-based solution.



Connected to a notebook PC, the WaveBook processes a variety of waveforms. This data is used to program special software for fine-tuning cochlear implants — enabling the profoundly deaf to hear.

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the smart approach to instrumentation™

IOtech's Solution

The biomedical company chose the WaveBook, IOtech's 1-MHz portable PC-based data acquisition system. The WaveBook was ideal for capturing waveforms because of the system's ability to collect multiple channels of data. In addition, the system's 16-bit analog-to-digital converter provided the required resolution for accurate harmonic reproduction of the waveforms, which were saved to the attached PC's hard drive and storage disks.

The WaveBook's ability to accurately collect a wide variety of waveforms, including complex, swept amplitude, swept frequency, and any combination of these waveforms was a great benefit. The system's ability to record large data files also was a great benefit, as it gave the test operator the expanded flexibility to experiment with different solutions to ensure that patients would be able to hear all possible audio frequencies evenly.

Conclusion

Using the WaveBook, researchers were able to develop a valuable software program that enables profoundly deaf patients to hear using cochlear implants. With this software, not only are implant adjustments easy to make, but now test operators have the flexibility to experiment with new techniques that may improve each patient's hearing. The WaveBook's memory capability, high-speed acquisition, and PC interface made it an ideal test system.

WaveBook Series

The WaveBook™ series of portable and desktop digitizers offer multi-channel waveform acquisition and analysis for portable or laboratory applications. All WaveBook models include 8 built-in channels expandable up to 72 channels of voltage, accelerometer, microphone, strain gage, thermocouple, position encoder, frequency, high voltage, and other signal types. For applications beyond 72 channels, up to four WaveBooks can be combined within one measurement system, for a total capacity of 288 channels. WaveBooks are available with either an Ethernet or parallel connection to a PC.

Features

- PC connection via Ethernet, parallel, PC-Card, or PCI card
- 1 µs/channel scanning of any combination of channels
- Expandable up to 288 high-speed channels
- SYNC connection allows multiple units to measure synchronously
- Add up to 224 lower-speed thermocouple channels
- DSP-based design provides real-time digital calibration on all channels
- Single and multichannel analog triggering with programmable level and slope
- Digital TTL-level and pattern triggering
- Pulse trigger and external clock
- Programmable pre- and post-trigger sampling rates
- Sixteen 1-MHz digital inputs
- Operable from AC line, a 10 to 30 VDC source, such as a car battery, or optional compact rechargeable battery module

Using WaveView software's spreadsheet-style interface, you can easily set up your application and begin taking data within minutes of connecting your hardware, with no programming required.

Included Software

- WaveView™ for *Out-of-the-Box*™ setup, acquisition, and real-time display:
  - Scope mode for real-time waveform display
  - Logger mode for continuous streaming to disk
- eZ-Analyst™ for real-time spectrum analysis
- Export data in third-party formats
- Includes drivers for Visual Basic®, Delphi™, C++ for Windows®; DASYLab®, and LabVIEW®
- ActiveX/COM development tools

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