Starkey Neuro Processor: A new beginning in sound processing architecture

Jon Kindred, Ph.D.

At the core of all hearing aids is the sound processing chip that determines how sounds are processed, so that the hearing aid wearer can better access the auditory cues that help their understanding of speech and the environment around them. The Starkey Neuro Processor is the brain of the Genesis AI family of hearing aids. Our all-new processor is smaller, faster, and more power efficient while delivering significantly higher processing capabilities.

Introduction

It has been close to three decades since the first digital hearing aids were introduced to the industry. The transition to a digital hearing aid system allowed for sounds to be processed more effectively and drove the development of sophisticated algorithms to help speech understanding for hearing impaired individuals. An integrated circuit, the more formal name for a processing chip, consists of a variety of computational structures that work in concert to perform tasks and calculations. Technological advances in the electronics industry today mean that hearing aid sized integrated circuits can now be made smaller and packed with hundreds of millions of electronic elements capable of more sophisticated processing.

The Starkey Neuro Processor has our best of everything, delivered in a smaller package. It features up to 4 times faster processing than its earlier generation, with 6 times more transistors, 5 times more computational memory, and 10 times more non-volatile memory. It is also more efficient than its earlier generation, consuming at least 50% less battery power when providing similar computational processing.

New and improved upgrades

- Industry's highest input saturation level, and an improved circuit noise floor of 10 dB
- New microprocessor to handle Deep Neural Network (DNN) interactions and other audio processing
- Dedicated structure for DNN processing
- Direct Memory Access and synchronization block improvements to regulate computational traffic and streaming synchronization
- 5 times more working memory and 10 times more non-volatile memory for more sophisticated features
- 6 times more transistors that are also smaller mean more computational capability and savings in processing power for Genesis AI

The Starkey Neuro Processor features a few new and significant upgrades. Of the programmable processors onboard the Starkey Neuro Processor, there are two new additions: a dedicated DNN and a new type of microprocessor. The addition of new programmable processors with specialized capabilities, enables our digital signal processing to be more efficient with the processing loads targeted to each type of processor.

At the heart of artificial intelligence processing is hardware dedicated to running DNN algorithms. These networks execute much more efficiently on physical structures that are tailored for this type of processing, allowing for better and more sophisticated processing than ever before. The DNN accelerator emulates the way the auditory cortex identifies environmental sounds and is used in acoustic adaptations for speech enhancement.

The new microprocessor orchestrates the operations of the DNN and handles other audio processing such as audio streaming. Improvements to the internal architecture allow different types of streamed signals to be automatically classified and customized with frequency shaping vectors to help improve the listening experience.

Outside of the programmable processors, the Starkey Neuro Processor has made significant improvements in audio input processing capabilities. The 20 dB improvement in the circuit dynamic range allows for the input saturation level to increase from 108 dB SPL to 118 dB SPL, and lowers the circuit noise floor by 10 dB. To the listener, audio signals with high peaks, like music, will now sound more natural, enhancing the overall listening experience.

The Direct Memory Access and audio synchronization blocks are also improved, allowing for better regulation of computational traffic and the handling of streaming synchronization, so that the primary audio processors can focus on more complex processing of sounds.

With more complex processing comes the need for greater memory capacity to handle new and improved audio processing features. The Starkey Neuro Processor features five times the amount of working memory. The substantial increase in memory is one of the more important upgrades as more memory works in tandem with all the processing power needed for complex algorithms.

The equivalent of the hard drive of the hearing aid, the non-volatile memory, is now ten times larger and allows for more sophisticated voice indicators, larger code size, more data logging, and faster firmware upgrades.

This greater memory capacity is enabled by a smaller transistor size, which in turn allows for more transistors on chip. Another advantage of smaller transistors is that they can operate at a lower voltage and consume less current. This reduction in processing power saves battery life in the short term and enables more algorithms to be added in the future. The Starkey Neuro Processor also continues to support other features that promote healthy living and is able to accommodate more improvements that help patients hear better and live better.

Conclusion

The Starkey Neuro Processor is our most advanced system to date, architected to be the strong foundation from which we will continue to develop groundbreaking technology. Smaller, faster, and smarter, Genesis AI is breaking the sound barrier, and it's just the beginning of what is possible.

Read more about Starkey research here: https://www.starkeypro.com/continue-learning/research-and-publications

Author Biography

Jon Kindred, Ph.D. is a Technical Fellow at Starkey. He earned his B.S. and M.S. degrees in electrical engineering at the University of Illinois and his Ph.D. at Northwestern University with an emphasis in digital signal processing. Since joining Starkey in 1998, Jon has worked on algorithm development, management roles for several technical disciplines, and has served in the role of Technical Fellow since 2013.

Lead editors: Jamie Hand, Au.D. (Marketing Communications) and Christine Tan, Ph.D. (Product Marketing)