Neural Engineering System Design (NESD)

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The Neural Engineering System Design (NESD) program seeks to develop high-resolution neurotechnology capable of mitigating the effects of injury and disease on the visual and auditory systems of military personnel. In addition to creating novel hardware and algorithms, the program conducts research to understand how various forms of neural sensing and actuation might improve restorative therapeutic outcomes.

The focus of the program is development of advanced neural interfaces that provide high signal resolution, speed, and volume data transfer between the brain and electronics, serving as a translator for the electrochemical language used by neurons in the brain and the ones and zeros that constitute the language of information technology. The program aims to develop an interface that can read 106 neurons, write to 105 neurons, and interact with 103 neurons full-duplex, a far greater scale than is possible with existing neurotechnology.

To succeed, NESD requires integrated breakthroughs across disciplines including neuroscience, low-power electronics, photonics, medical device packaging and manufacturing, systems engineering, and clinical testing. In addition to hardware, NESD performer teams are developing advanced mathematical and neuro-computation techniques to first transcode high-definition sensory information between electronic and cortical neuron representations and then compress and represent those data with minimal loss of fidelity and functionality.

If the program is successful, the work has the potential to significantly advance scientists' understanding of the neural underpinnings of vision, hearing, and speech and could eventually lead to new treatments for injured Service members living with sensory deficits. Additionally, NESD tools could yield new understanding of the architecture and processing of highly integrated neural circuits.