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Adaptive Neurotechnology for Making Neural Circuits Functional .

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Two of the most important trends in recent technological developments are that technology is increasingly integrated with biological systems and that it is increasingly adaptive in its capabilities. Neuroprosthetic systems that provide lost sensorimotor function after a neural disability offer a platform to investigate this interplay between biological and engineered systems. Adaptive neurotechnology (hardware and software) could be designed to be biomimetic, guided by the physical and programmatic constraints observed in biological systems, and allow for real-time learning, stability, and error correction. An example will present biomimetic neural-network hardware that can be interfaced with the isolated spinal cord of a lower vertebrate to allow phase-locked real-time neural control. Another will present adaptive neural network control algorithms for functional electrical stimulation of the peripheral nervous system to provide desired movements of paralyzed limbs in rodents or people. Ultimately, the frontier lies in being able to utilize the adaptive neurotechnology to promote neuroplasticity in the living system on a long-time scale under co-adaptive conditions.