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Neural Dust and Neural Interfaces

A major hurdle in brain-machine interfaces (BMI) is the lack of an implantable neural interface system that remains viable for a lifetime. I will discuss Neural Dust, a concept developed with Elad Alon, Jose Carmena and Jan Rabaey, which explores the fundamental system design trade-offs and ultimate size, power, and bandwidth scaling limits of neural recording systems built from low-power CMOS circuitry coupled with ultrasonic power delivery and backscatter communication. In particular, we propose an ultra-miniature as well as extremely compliant system that enables massive scaling in the number of neural recordings from the brain while providing a path towards truly chronic BMI. These goals are achieved via two fundamental technology innovations: 1) 10 - 100 micron scale, free-floating, independent sensor nodes, or neural dust, that detect and report local extracellular electrophysiological data, and 2) a sub-cranial interrogator that establishes power and communication links with the neural dust.