Real-time chemical microsensors hold great promise for investigating brain function and pathology. Their defining analytical characteristic is the capability to interrogate the activity of a single neuron type, by virtue of identifying the released neurotransmitter. This measurement modality affords dopamine monitoring with subsecond temporal resolution at voltammetry (FSCV) at a carbon-fiber microelectrode (CFM). Great strides have also been made in wireless integrated circuits (ICs) supporting this ground-breaking technology. Such an extension would provide an innovative and powerful addition to the neurobiology toolkit by enabling quantitative and meticulous investigations of the cellular, molecular and behavioral effects of various neurochemical profiles recorded during widely studied behavioral paradigms. Precise neurochemical pattern generation could also have additional clinical bearing by providing the framework for ultimately developing new neuromodulation devices that can impose therapeutic neurochemical profiles or maintain additional clinical bearing by providing the framework for ultimately developing new neuromodulation devices that can impose therapeutic neurochemical profiles or maintain.

We have developed an integrated microsystem that uniquely combines electrical stimulation with embedded timing management, which permits external triggering of individual stimulus pulse trains, for generation of neural activity patterns in vivo and wireless neurochemical sensing for subsequent assessment of fidelity in the generated profiles. Utilizing a transfer function, the correlation coefficient between predicted and measured dopamine temporal profiles was found to be 0.95, demonstrating high-fidelity artifact-free neurochemical pattern generation in vivo.

**PROJECT GOAL**

**EXPERIMENTAL RESULTS**

Dopamine temporal pattern generation using a transfer function that relates electrical stimulation to evoked brain dopamine dynamics.

Simulated vs. measured temporal patterns of electrically evoked dopamine levels in the dorsal striatum of an anesthetized rat for the stimulus protocol used for pattern prediction and generation with the transfer function (right). Each vertical tick in the plots represents one stimulus trigger from the home-base computer. A correlation coefficient, \( r = 0.95 \) between the predicted and measured profiles verified high fidelity in neurochemical pattern generation by the SoC.

Current measured at a CFM implanted in the dorsal striatum of an anesthetized rat when the medial forebrain bundle (MFB) was stimulated with biphasic current pulses. Stimulus onset is denoted by the arrow on the plot. Without electrode switching, a very large stimulus artifact appeared on the CFM and no dopamine response could be detected. With electrode switching, dopamine was recorded artifact-free.

**REFERENCES**

