Session 532 - Software Tools I

532.21 / WW38 - WAVESURFER, a freely available data acquisition, signal generation, and device control software package for experimental neuroscience

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Authors
***J. M. BARRETT**[1], A. L. TAYLOR[2], L. S. LAMBOT[1], X. LI[1], H. INAGAKI[2], K. SVOBODA[2], B. KIMMEL[3], G. M. G. SHEPHERD[1];
[1]Dept. of Physiology, Feinberg Sch. of Med., Northwestern Univ., Chicago, IL; [2]Janelia Res. Campus, Howard Hughes Med. Inst., Ashburn, VA; [3]Vidrio Technologies, Ashburn, VA

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Abstract
Modern neuroscientific experiments require coordinating disparate pieces of hardware, each which distinct interfaces and control software, for the collection of different signals of interest (e.g. electrophysiological, optical, behavioral) and generation of stimuli in multiple modalities (e.g. electrical, optical, auditory, tactile). One approach to achieving this is to write custom experimental control routines, but this is time-consuming, requires programming skills, and is relatively inflexible if the experimental configuration needs to be changed.
WaveSurfer (wavesurfer.janelia.org) – which incorporates features of an earlier software package, Ephus (Suter et al., 2010) – represents an alternative approach. WaveSurfer coordinates electrophysiological recording & stimulation, acquisition & generation of arbitrary 1D analog signals, and triggering of external devices. WaveSurfer has a simple yet flexible user interface, which allows experiments to be reconfigured on the fly. Custom Matlab code can be invoked at different points to allow for online analysis or more sophisticated experiments, including closed-loop experiments. WaveSurfer is compatible with National Instruments X series data acquisition boards and any patch-clamp amplifier, with particular integration for Axon and Heka amplifiers. WaveSurfer can be integrated with ScanImage (Vidrio) for laser scanning microscopy and photostimulation, including two-photon imaging. Here, we demonstrate how WaveSurfer's capabilities allow it to be used in a variety of experimental configurations.
WaveSurfer can be used for slice electrophysiology to deliver arbitrary voltage or current stimuli, as well as multi-wavelength optical stimulation using LEDs or lasers. We have also used WaveSurfer for in-vivo transcranial calcium imaging combined with Micro-Manager (Edelstein et al., 2014) and Retiga 2000DC cameras (QImaging), for synchronizing optical recordings with piezoelectric tactile stimulation, and for monitoring breathing to deliver respiration-locked optogenetic stimulation.
In conclusion, WaveSurfer is a simple yet powerful, flexible, and extensible experimental control and data acquisition program. Originally designed for slice-based electrophysiology, we are currently using it in our labs for a wide variety of neuroscientific experiments.