

The Real-Time eXperiment Interface: a closed-loop, open-source data acquisition platform with sub-millisecond latencies for electrophysiology

Ansel George⁽¹⁾, Yogi A. Patel⁽²⁾, Francis Ortega⁽¹⁾, John White⁽³⁾, David Christini⁽¹⁾, Allen Dorval⁽³⁾, Robert J. Butera⁽²⁾

(1) Weill Cornell Medical College, New York, NY (2) Georgia Institute of Technology, Atlanta, GA (3) The University of Utah, Salt Lake City, UT

The Real-Time eXperiment Interface, or RTXI, is a closed-loop, hard real-time data acquisition and control system for electrophysiology. It is an interaction between many open-source initiatives that provides a mature and extensible framework for designing and carrying out experiments. RTXI is free and runs on almost any modern desktop. All that's needed is a compatible data acquisition card. It can be used to simultaneously handle multichannel data acquisition through a growing set of hardware, computational models of moderate complexity, and recording to disk - all at microsecond latencies. To date, it has been used by over 60 labs around the world.



Announcing RTXI 2015!

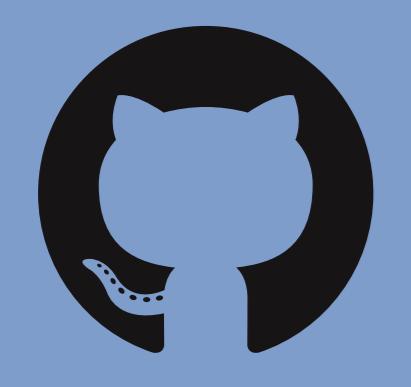
A conference focused the use of RTXI for real-time, closed-loop methods in electrophysiology.

May 7th-8th in Atlanta, GA - more info available at rtxi.org!

Learn more

www.rtxi.org

Fork us on github



github.com/rtxi

Key features

Modular framework

- + features implemented as stand-alone modules
- + dynamic loading/unloading of modules into signal chain
- + written in C++ with GUI elements using Qt
- + user-specific modules easy to create and implement

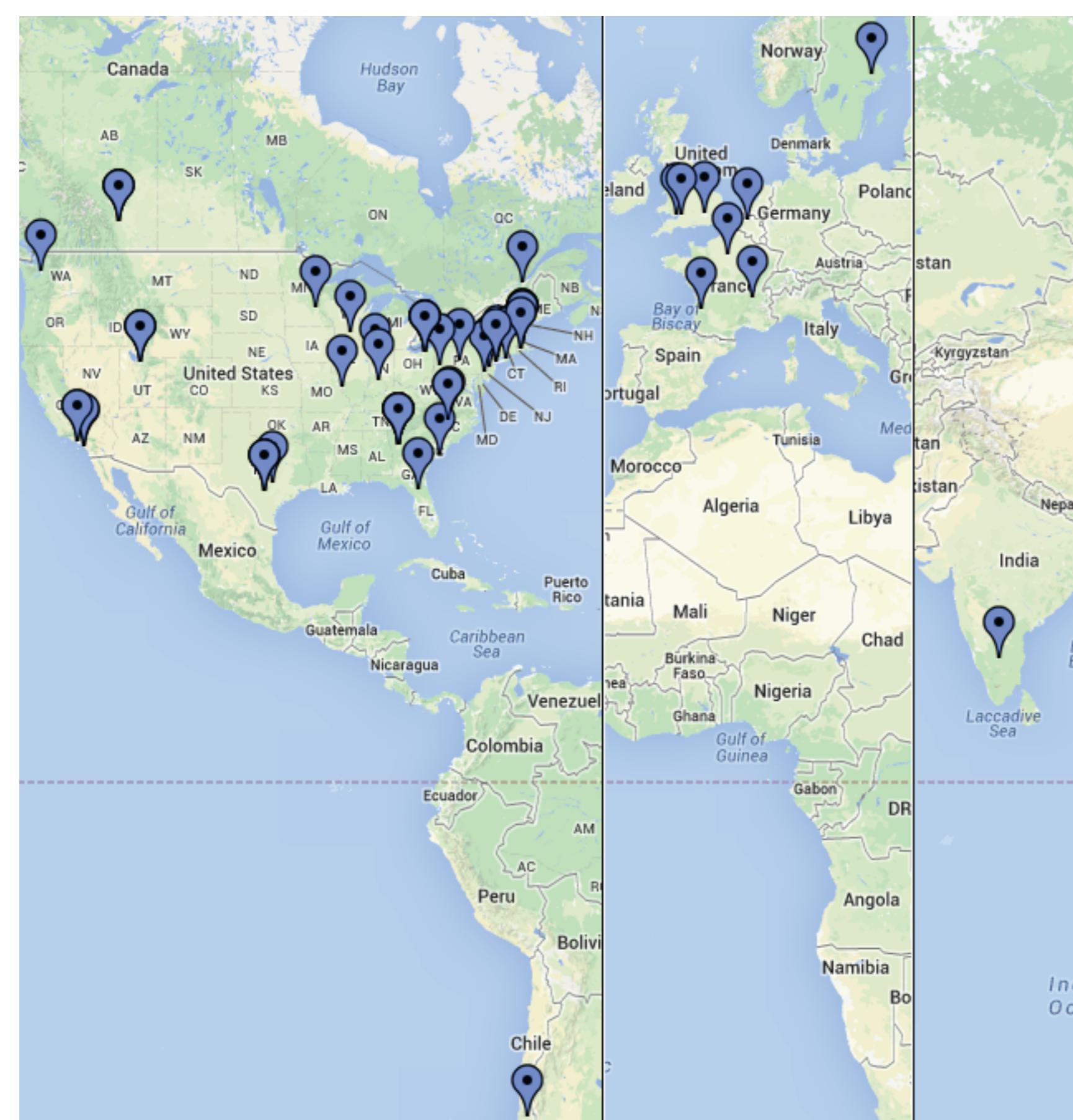
Free and open-source

- All code open-source
www.github/rtxi

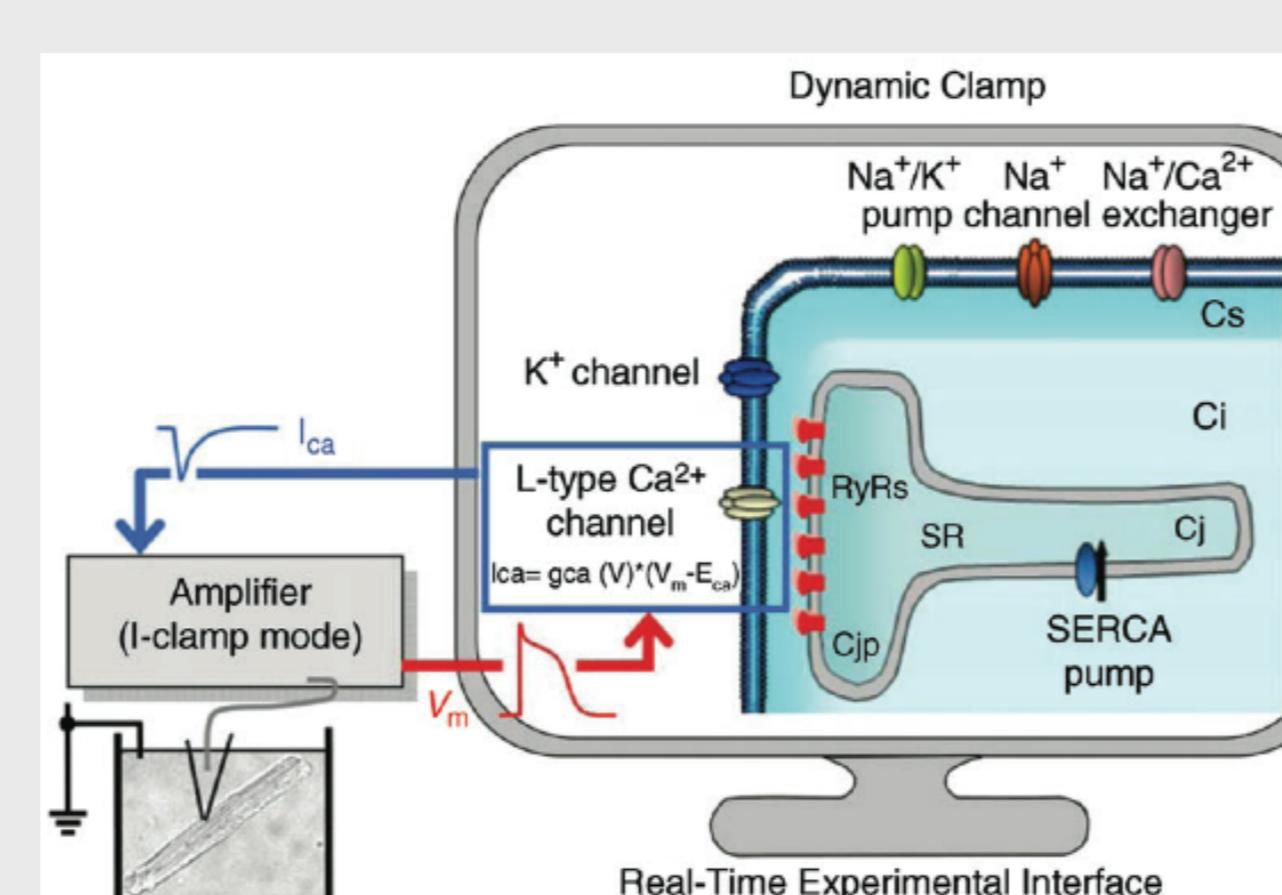
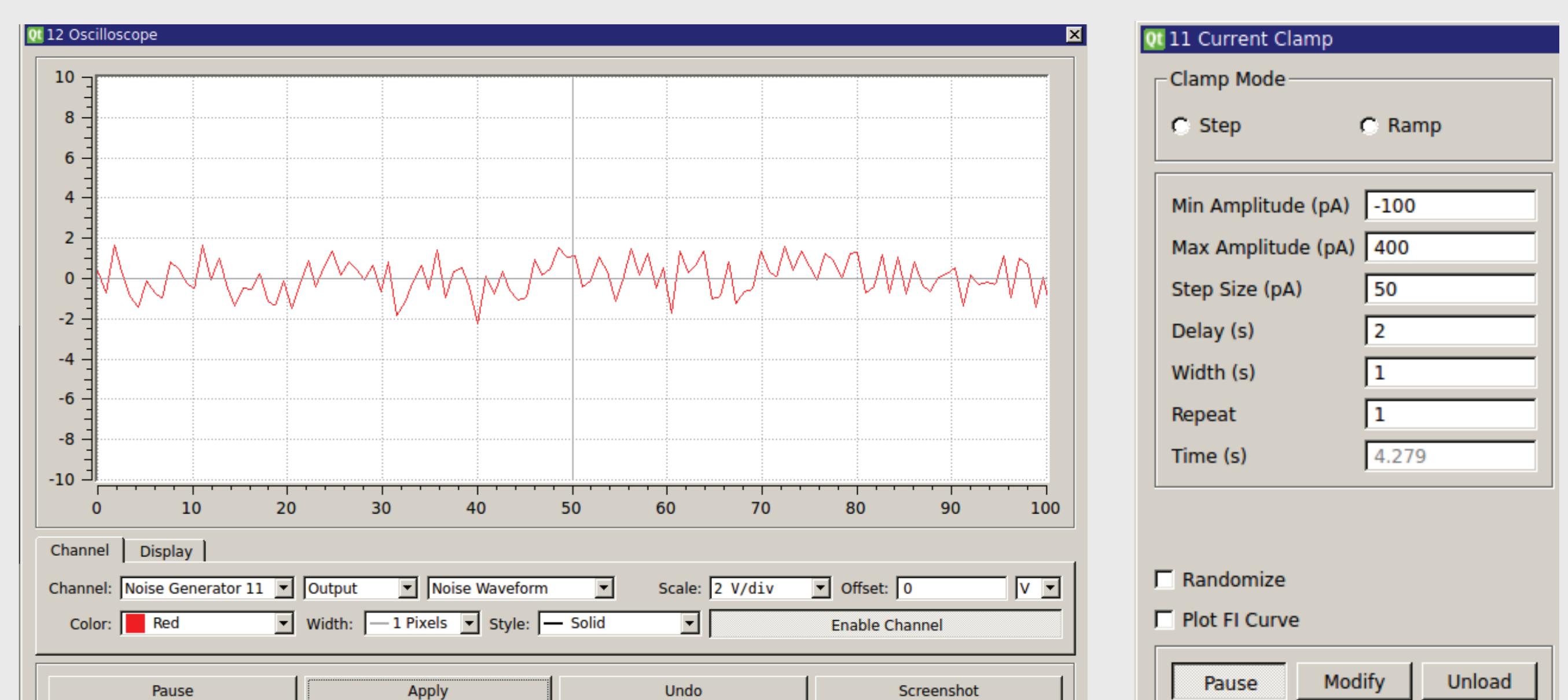
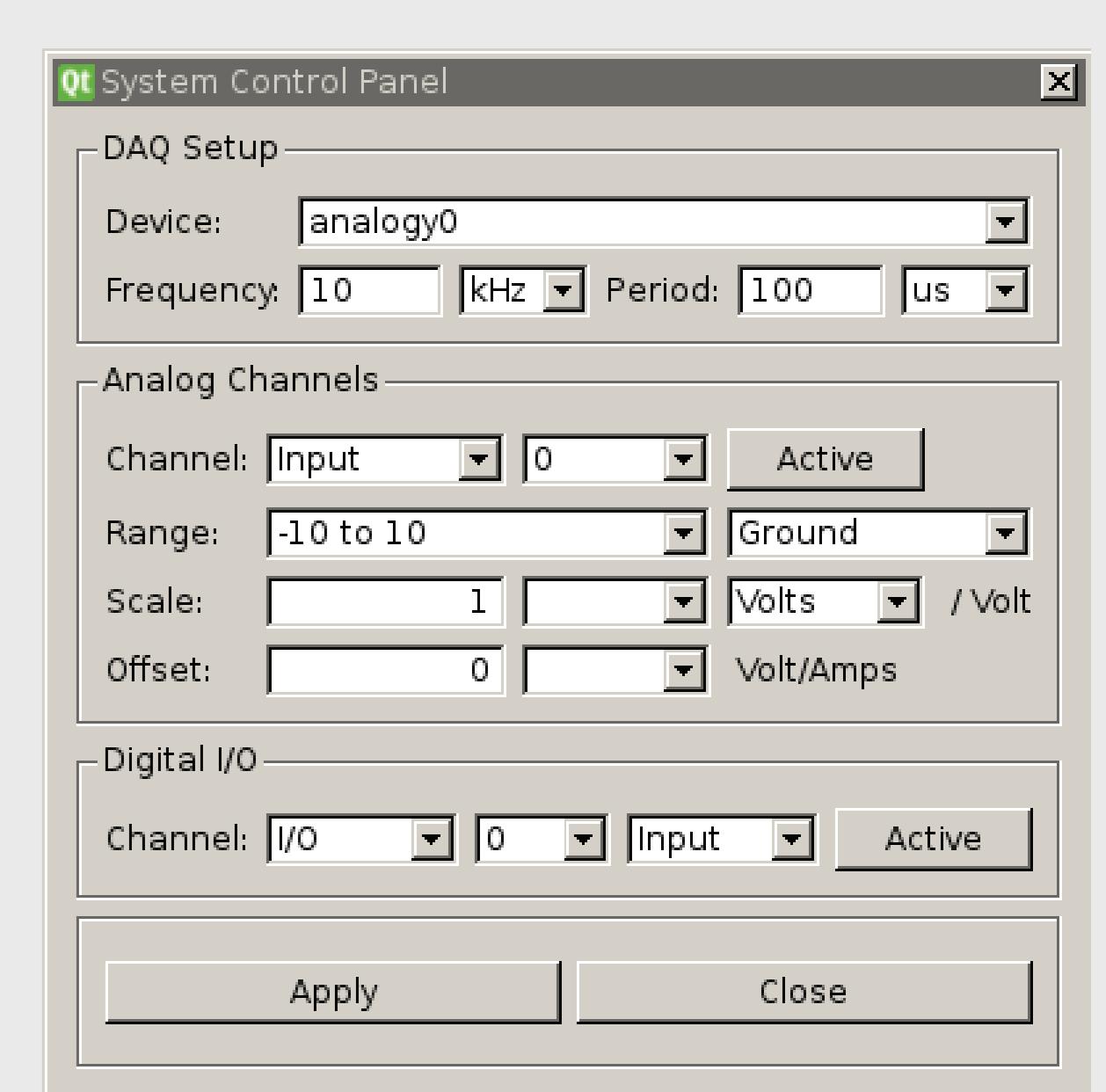
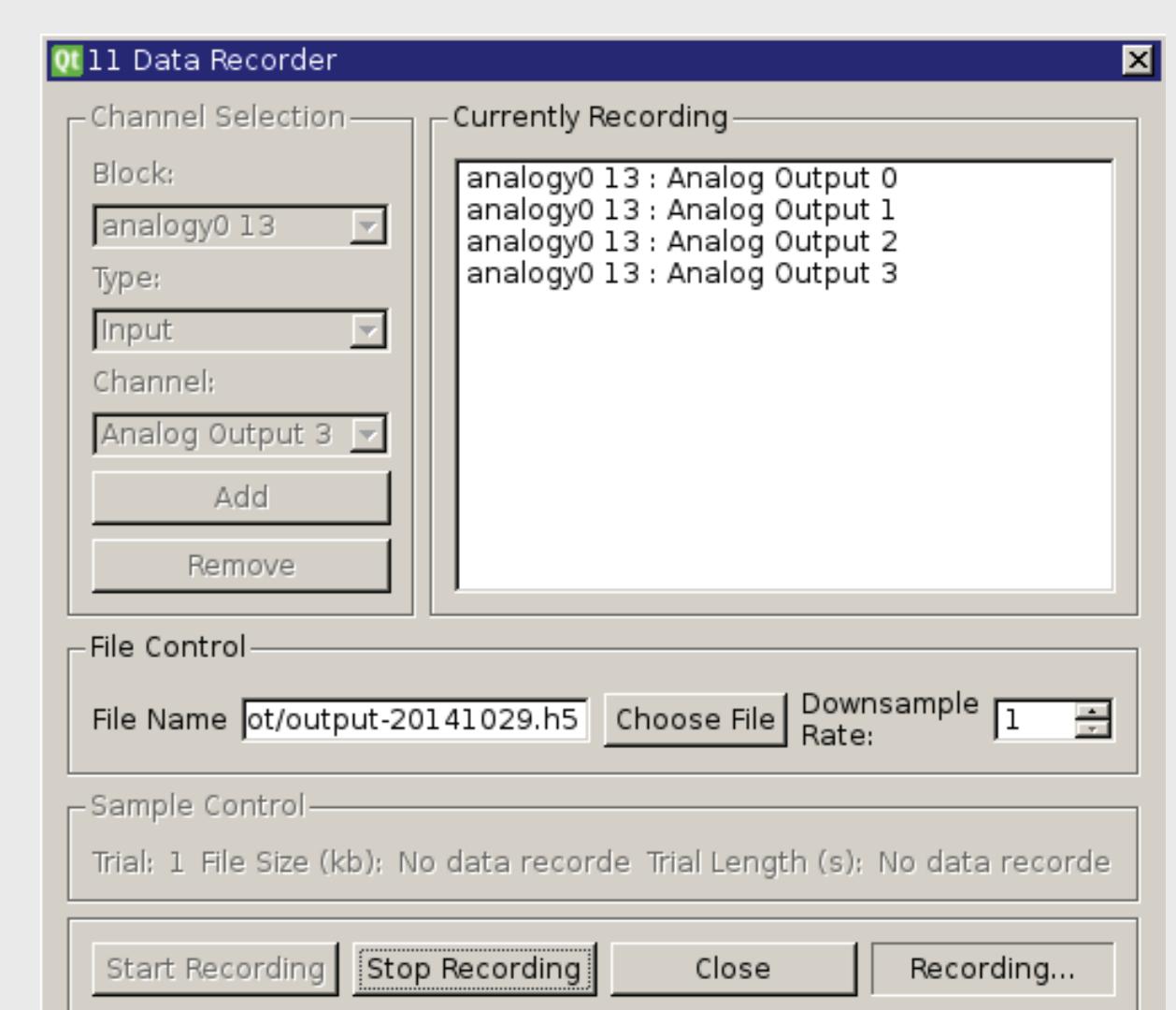
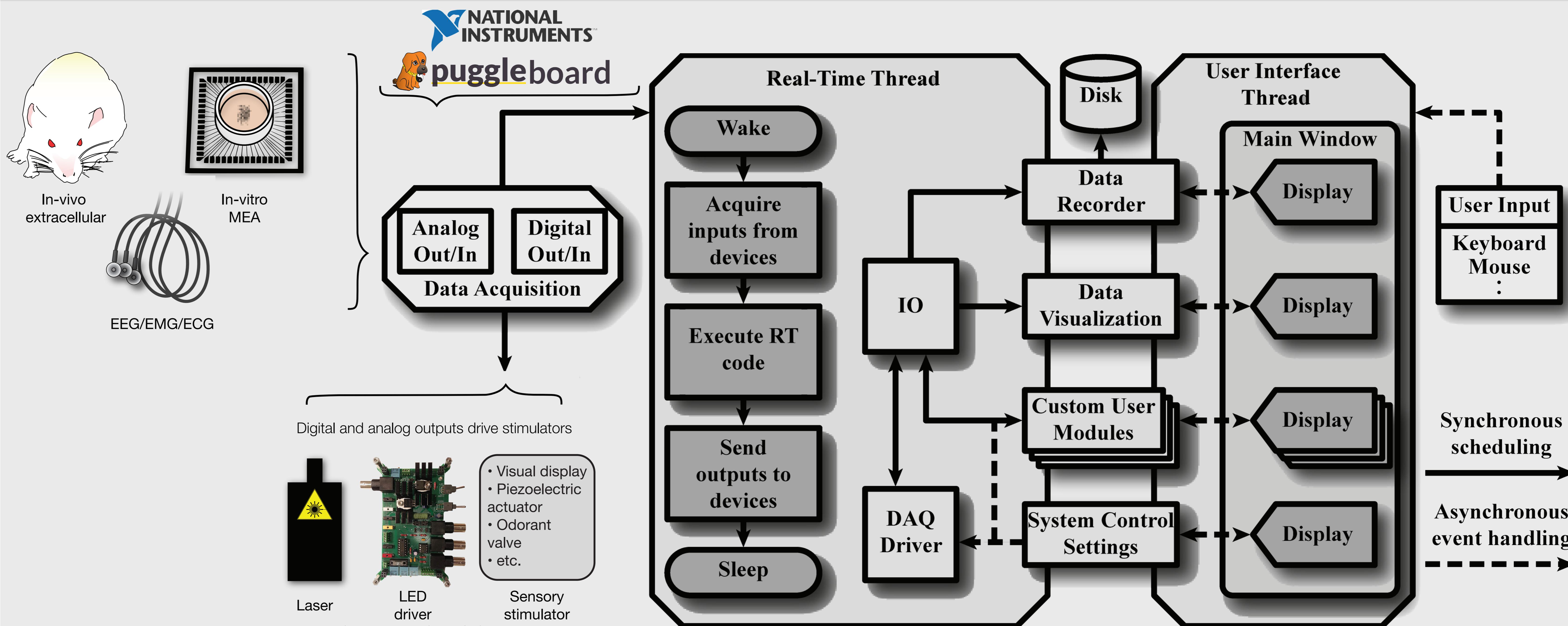
Linux: free to use and compatible with any modern desktop

Xenomai: modification to Linux Kernel enabling deterministic timing

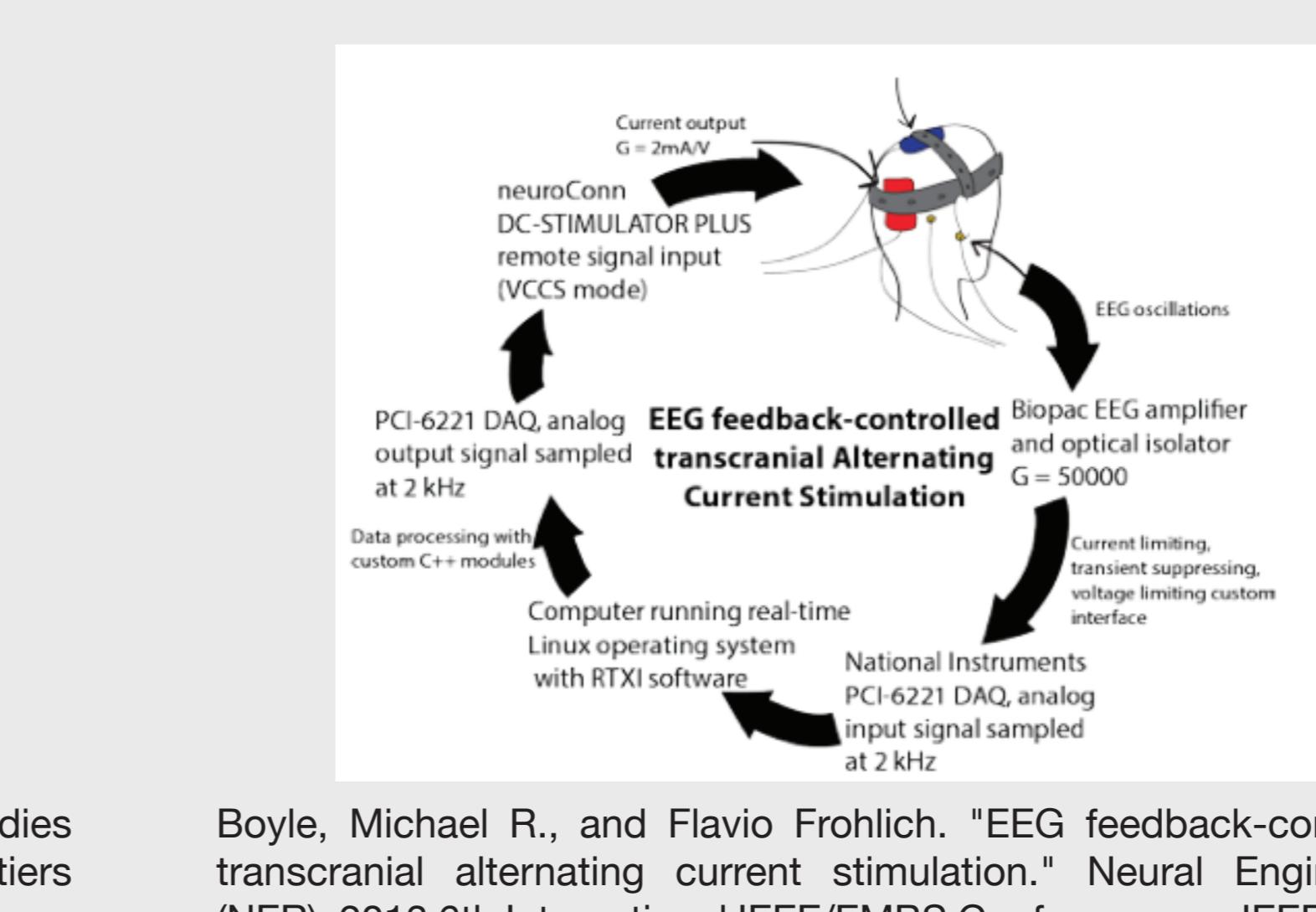
Analogy: community driven driver-set for a variety of acquisition cards



Hardware and software overview



Madhvani, Roshni V., et al. "Shaping a new Ca^{2+} conductance to suppress early afterdepolarizations in cardiac myocytes." The Journal of physiology 589.24 (2011): 6081-6092.



Skocik, Mike, and Alexey Kozhevnikov. "Real-time system for studies of the effects of acoustic feedback on animal vocalizations." Frontiers in neural circuits 6 (2012).

Acknowledgements

- RTXI community
- Xenomai RTLinux community
- Linux Kernel community
- NIH grant R01-RR020115 to R.J.B.
- Members of the White, Christini, and Butera labs

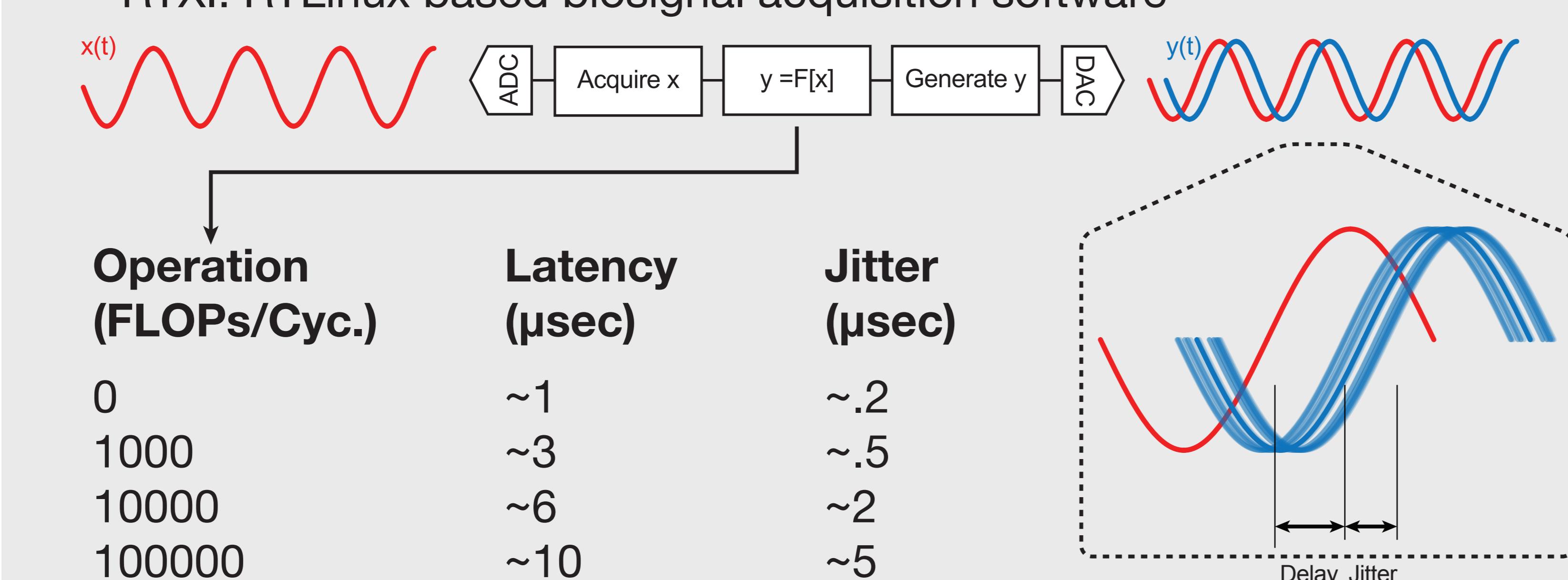
Abbreviations. **ADC** Analog to Digital Converter, **DAC** Digital to Analog Converter, **I/O** Input/Output, **EEG** Electroencephalography, **EMG** Electromyography, **ECG** Electrocardiography, **MEA** Microelectrode Array, **RTLinux** Real-Time Linux, **RTXI** Real-Time eXperimental Interface, **USB** Universal Serial Bus.



Hard real-time, closed-loop performance

Real-time kernel

- Real-time threads make loop times deterministic
- RTXI: RTLinux based biosignal acquisition software



Resources and development

Information available online:

- + official 32 and 64-bit Live CDs (v2.0)
- + source code (github)
- + publications with relevant RTXI modules
- + tutorials for installing RTXI and customizing modules
- + bug reports, feature requests, contact information

Other resources available:

- + full-time technical support via email/phone
- + on-site installation and troubleshooting support

