Using a Software-Defined Radio to Detect Amplitude Modulated Signals

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Cheap, Portable, Lock-in Detection

Stanford Research Systems'
SR530, a lock-in amplifier

www.thinkSRS.com

Drawbacks:

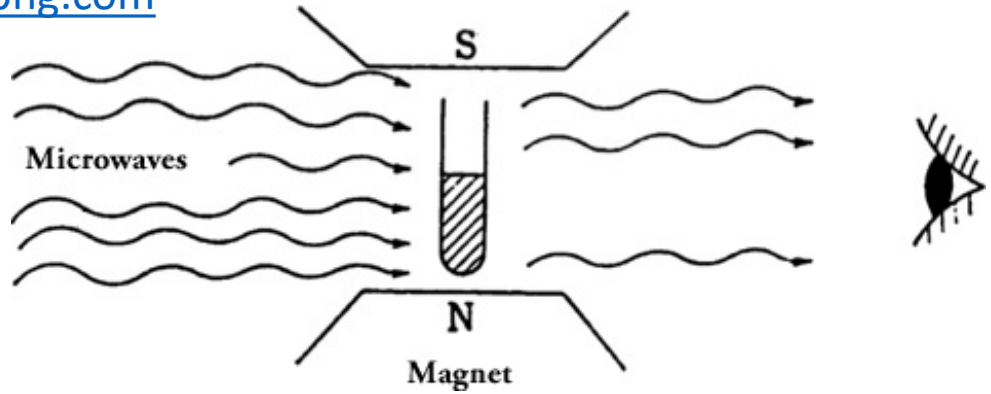
Cost	$ 3,000
Weight	16 lbs
Dimensions	17 ” x 5.25 ” x 17 ”
Power	120 V

When are Lock-ins Used?

Extracting a **weak "modulated" signal** from **strong random noise**

Examples!

www.cleanpng.com



Electron Spin Resonance

www.jeol.co.jp

Detecting an LED in a Bright Room

www.robotechbd.com

Software-Defined Radio ~ A Possible Substitute

Comparison:

Cost	1/14th
Weight	1/23rd
Dimensions	1/60th
Power	1/24th

Photo Courtesy: Valeria Viteri-Pflucker

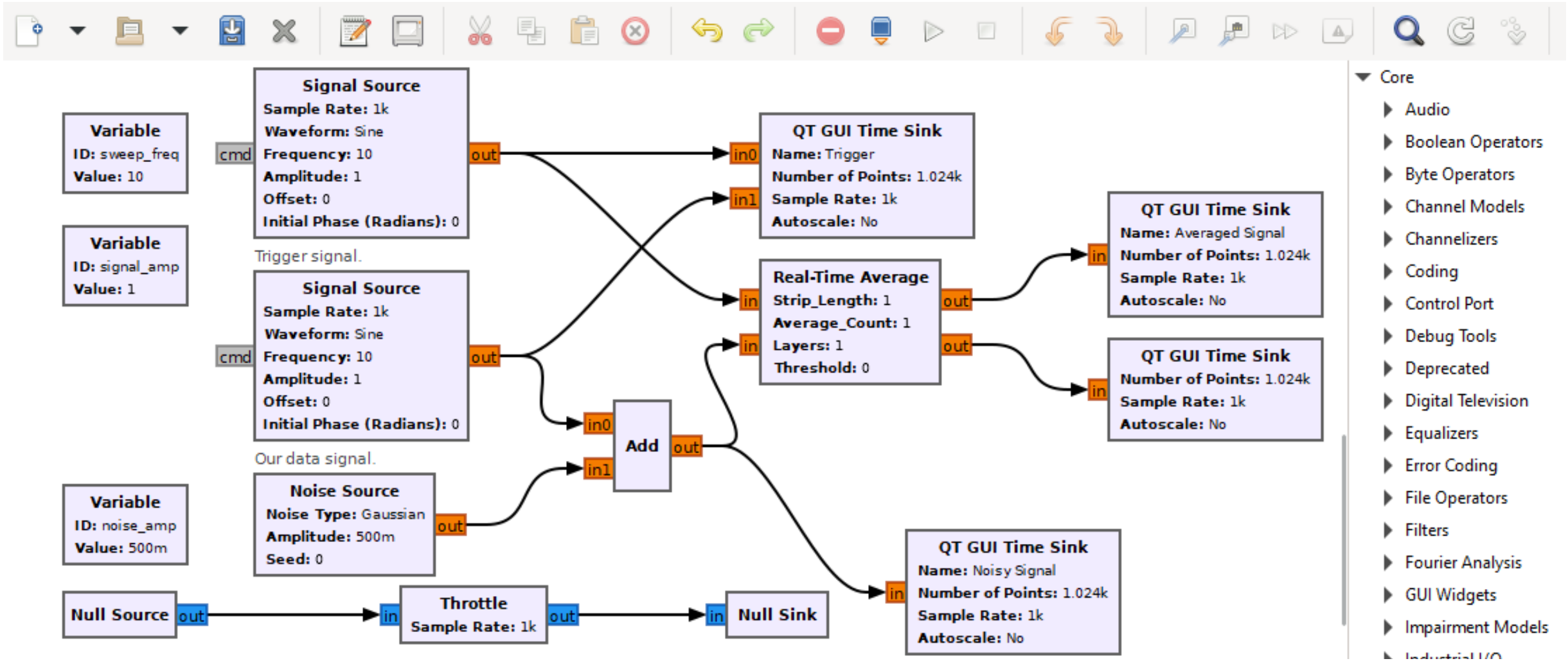
Radios mostly do what lock-in amplifiers do!

- Detect weak signals
- Wide frequency operation
- Extensive customizability

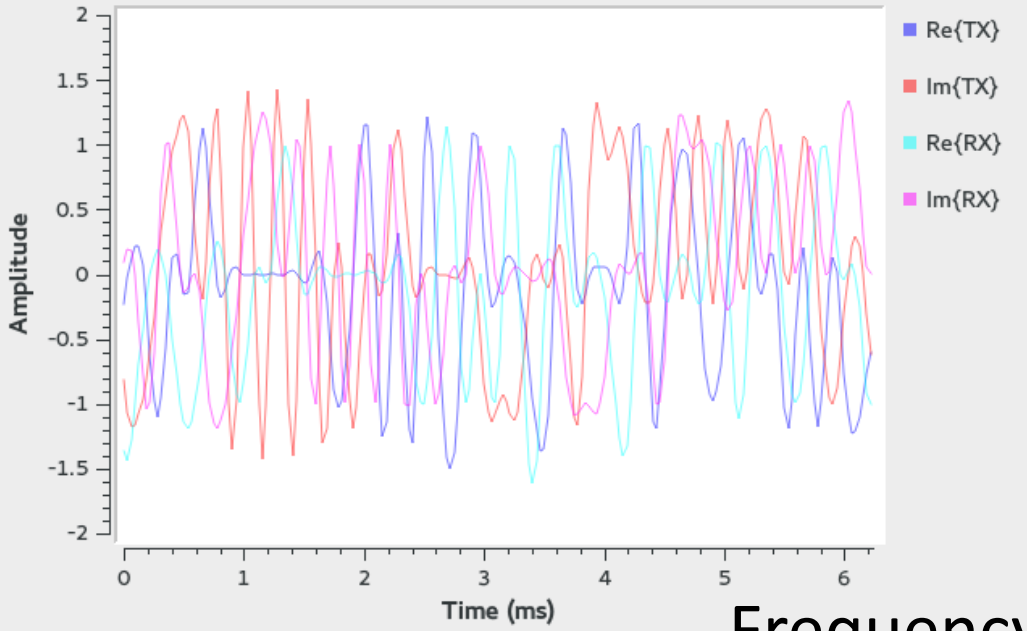
GNU Radio

THE FREE & OPEN SOFTWARE RADIO ECOSYSTEM

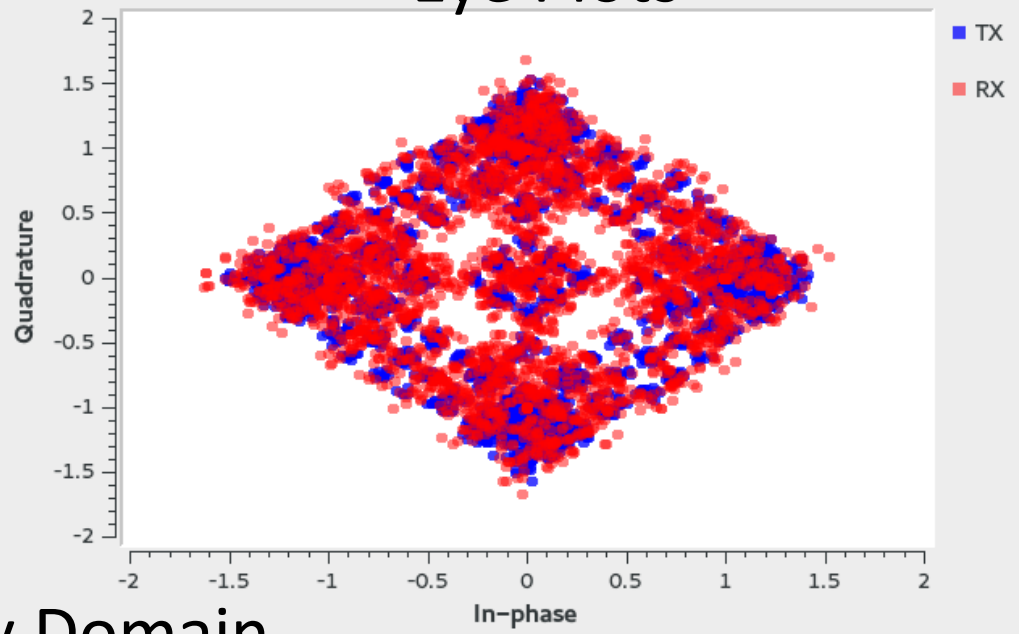
Unlimited flexibility… but at what cost?



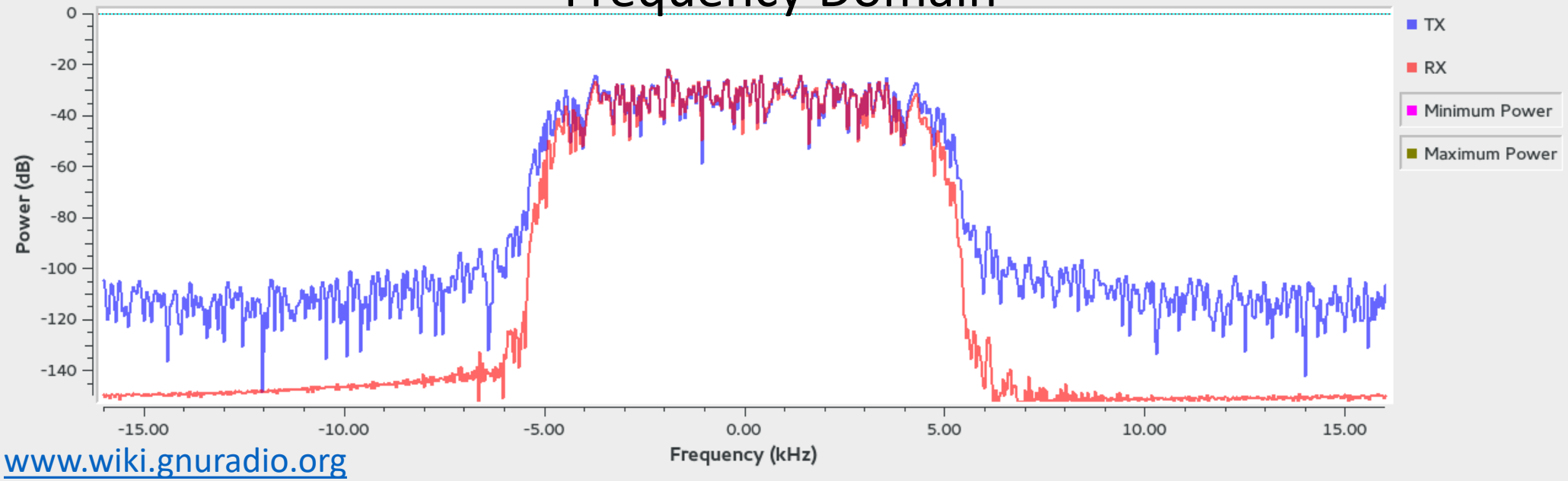
Time Domain



Eye Plots



Frequency Domain



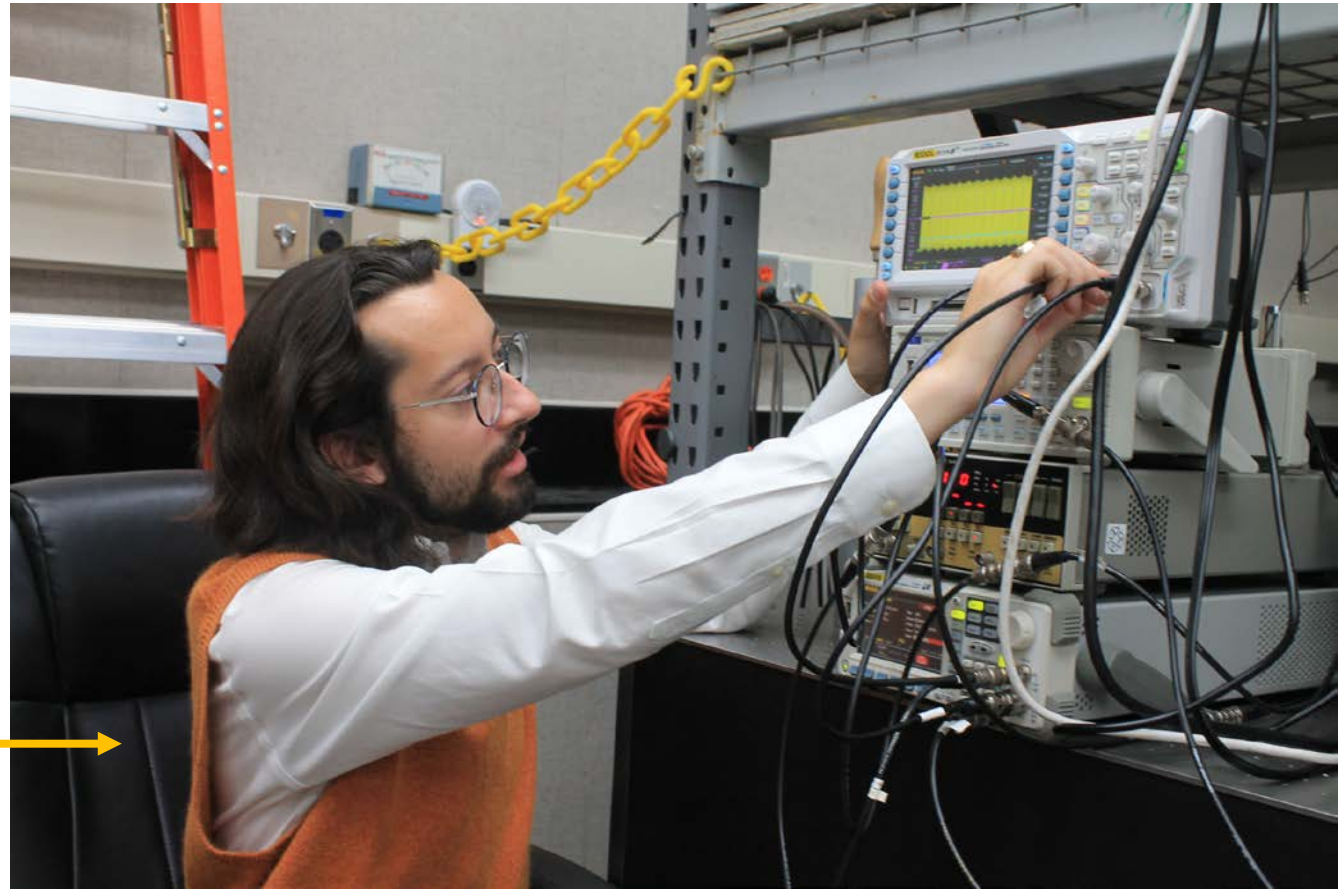
www.wiki.gnuradio.org

Extreme speed ~ Hardware Bottlenecks

Realized **hardware limitation** of USB 2 transfer rate (480Mbps)

Achieved sampling rate 25x faster than conventional audio devices!

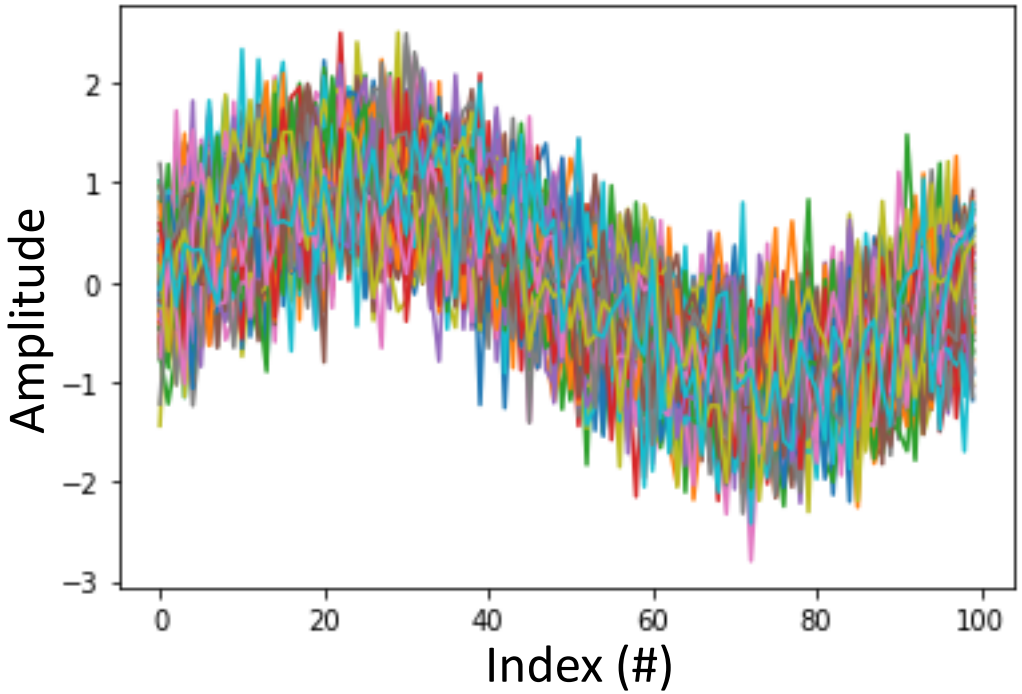
Photo Courtesy: Valeria Viteri-Pflucker



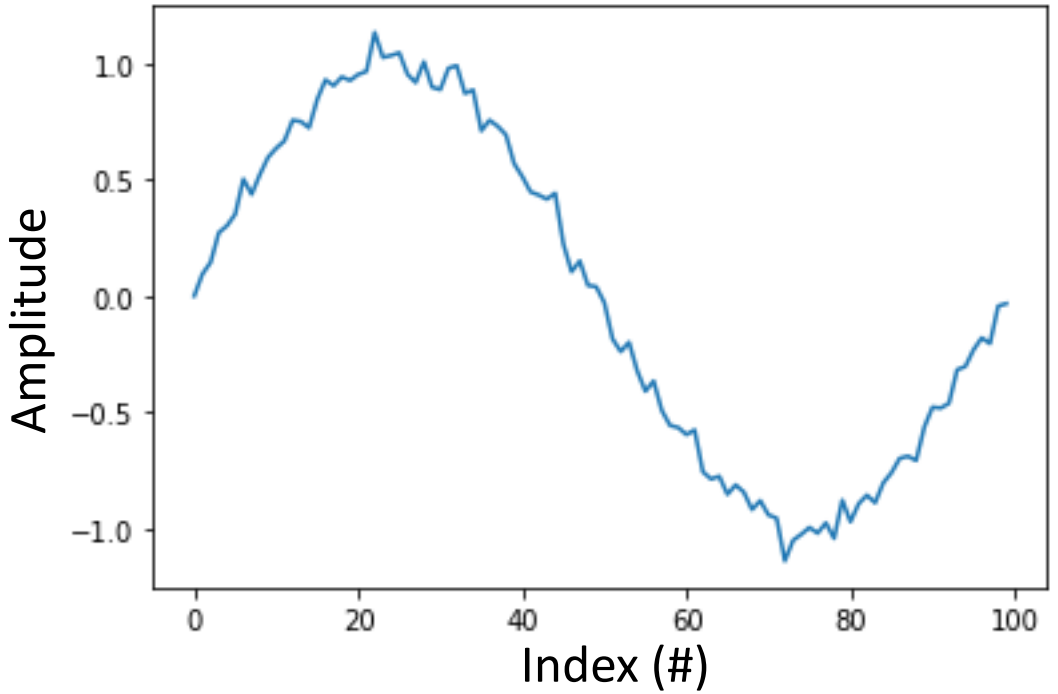
Designing and testing a complex signal with function generators and oscilloscope

Future testing plans:
Real-time signal averaging

From **noisy** inputs



To **strong** outputs



Possible, but progress is yet to be made in **synchronization** and visualization!

Thank you!

Any Questions?

- Dr. Charles Cheung, Joseph Kopanski and others at NIST for their guidance
- Dr. Franco Venturi for providing SDRplay support in GNU Radio
- SPS and the other fantastic interns for welcoming me to this opportunity