

Using the Tablets as Lab Devices

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Approach

- Using Linux
 - Enormous databases of free and open source software for data collection and analysis
 - Preferred development platform

Approach

- Software: Emphasis on realtime, intuitive data collection and analysis
 - Data should update at least 10 times per second
 - Controls should react immediately and continuously
- Hardware: Emphasis on portable, minimal data collection devices
 - Not so interested in fancy readouts and panels packed with dials

First Experiment: Acoustic Resonance

- The purpose of this lab is to have the student measure the resonance frequencies of tubes and compare to theoretical values.

Way back when..

- Long ago, this was done with a lot of hardware:
 - Amplifier fed by white noise generator, making noise on speakers
 - Large spectrum analyzer operates at 0.1 Hz
 - Expensive microphone
 - Cables everywhere

..and today

- One piece of software (www.baudline.com) generates white noise, records audio, and performs FFT in realtime
- Hardware required: one tablet, one microphone

Why is this so much better?

- Equipment requirements
- Realtime interface
 - Easier for the students to see what signals are real, which are noise
 - Easy to experiment
 - Only limited by my own creativity not the hardware
- Intuitive analysis – compare the sonogram view to the spectrum view

Another example

- Discreet knobs and dials are not intuitive
- Students often miss important information because they see only what the scope is showing them
- glScope demonstrates a more intuitive interface
(<http://luke.no-ip.org/code/downloads/glscope.tar.gz>)

Soundcard Drawbacks

- Limited frequency range 20Hz – 48kHz
 - No DC offset
- Limited dynamic range
- Poor signal quality

Not just limited to audio

- If you can work within the parameters of the sound card, it becomes a 16bit D/A converter with a lot of storage.
(example used Audacity
<http://www.audacity.sourceforge.net>)

Visual Input

- USB cameras
 - Not tied to a desktop framegrabber
 - Compact, lightweight
 - (http://www.ids-imaging.de/www/templates/uEye/uEye_e.htm)
- Custom software (<http://luke.no-ip.org/code/kueye/>)
 - Realtime feedback and useful analysis

Lab setup: measuring laser profiles

- In many experiments our students perform, they are required to measure the intensity profile of a laser beam
- Setup is often complex, and it is easy to make mistakes only seen later after analysis
- Students frequently have trouble recognizing noise and saturation
- How can we facilitate realtime analysis?

Other Input Devices

- USB or PCMCIA DAQ cards
- GPIB interfaces
- Serial interfaces