

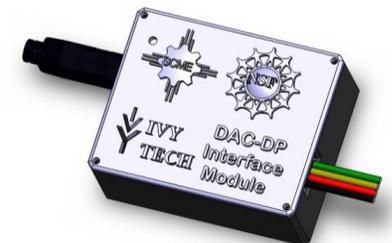
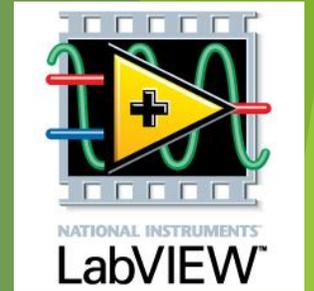
Using Arduino Uno and Labview in Teaching Natural Frequencies of SCME Microcantilevers Kits Workshop

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11/04/2020

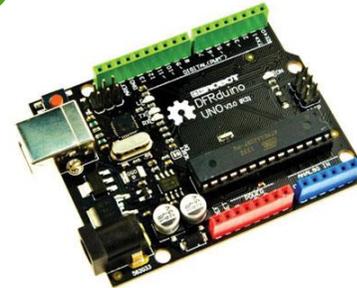
Using Arduino Uno and Labview in Teaching Natural Frequencies of SCME Microcantilevers Kits Workshop

Presenters will introduce how SCME kits can be used in the classroom as hands-on labs, and the use of Arduino Uno and LabView, two very popular products currently used in education and industry. Participants will use Arduino Uno microcontrollers and custom LabView software via a remote connection to determine how mass, material type, and dimension influence the resonant mode of vibration of cantilevers beams using the SCME Microcantilevers Kits. The Arduino Uno will be used as an inexpensive data acquisition device in tandem with a custom shield. The resonant mode of vibration will be measured with a homemade simple strain gauge. The software used is custom LabView code developed to display and calculate the resonant mode of vibration. The SCME kits will also be used along with the educational material these kits provide in MEMS and technician training. Attendees will receive details for ordering the kits prior to the conference.

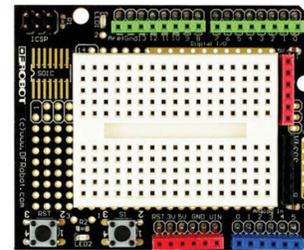


Arduino Uno

Specification	
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage	7-12V
Digital I/O Pins	14
Analog Input Pins	6
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
PC Interface	USB

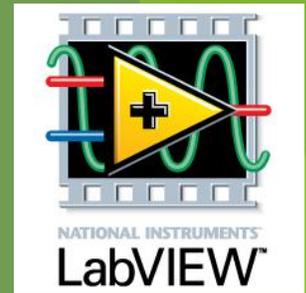


Arduino Uno



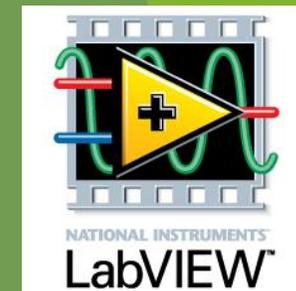
Prototype Shield

```
Wuxi4 | Arduino 1.0.6
File Edit Sketch Tools Help
Wuxi4
//WUXI Professional School of Science and Technology
//11/13/2014
//Code to control Single Axis Tracker Solar Panel & Limit Switches
int pbIn2 = 2;
int pbIn3 = 3;
//The two limit switches should be physically connected to pins 2
int ledOut12 = 12;
int ledOut13 = 13;
//The two limit switch LEDs are connect to pins 12 and 13 of the A
//When the state is high the limit switches is not engaged, i.e. t
int state2 = HIGH;
int state3 = HIGH;
//The states should both be high and would translate into the lim
int E1 = 4;
//This state of this pin enables or disable the motor drive.
int potPin = A0;
//The pot wiper should be connected to the A0 pin
int motorPin = 5;
//This state of this pin determines the direction of rotation of t
int potValue = 0;
//Initially the pot value is set equal to zero
int motorValue = 0;
//Initially the motor power value is set equal to zero
```



<https://www.arduino.cc/en/Main/ArduinoBoardUno>





DAC-DP CB.vi Front Panel

File Edit View Project Operate Tools Window Help

15pt Application Font Search

DAC-DP Cantilever beam

Student's name

Serial Port

Frequency

Altitude

Analyze collected data

Re-take data

Generate Report

Captured data

Analyzed data

Curve fit

Cursors:	X	Y
Cursor 0	1	NaN
Cursor 1	3.31065	1101.32

Cursor 0 value

Cursor 1 value

Curve fit method

Live data

Cantilever beam (Serial Interface)

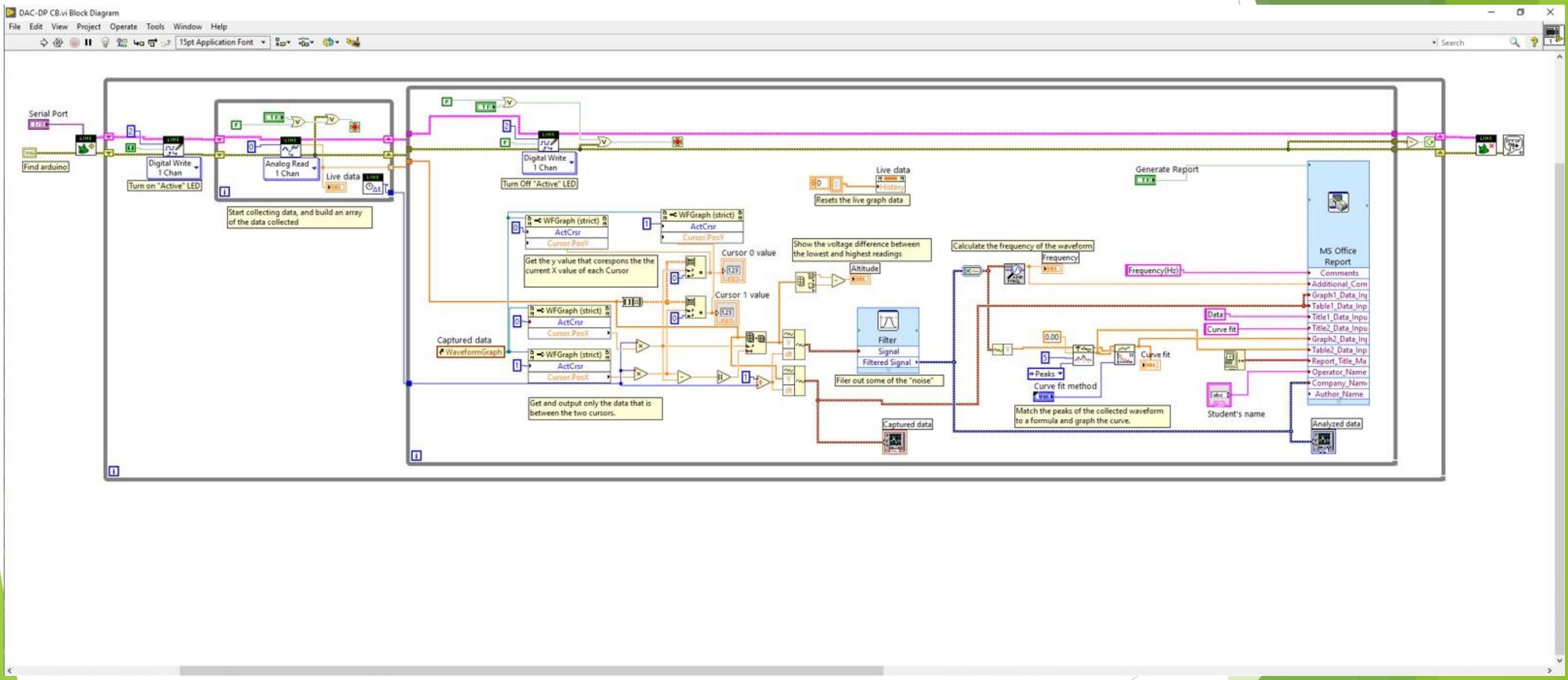
This program collects and analyses data from the SCME MEMS cantilever beam kit using the DAC-DP interface module via Serial / USB.

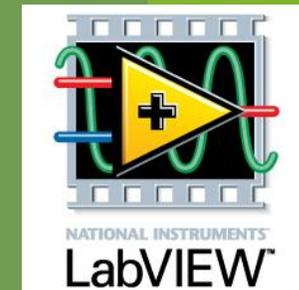
Instructions

1. Select the COM Port associated with the LINX Device.
2. Select the Analog Channel to read.
3. Click the Run Arrow.



The LabView code



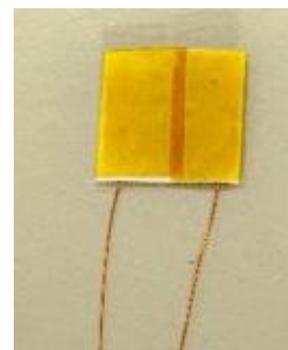
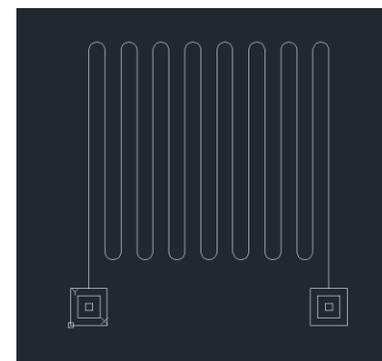


And we had to build our own strain gauges ...

How to make a strain gauge

What you will need

1. Silhouette cameo
2. Computer with Silhouette studio
3. Silhouette pen holder
4. Electroninks Circuitscribe conductive ink pen
5. Common white printer paper
6. Kapton tape 1" wide
7. 30ga Magnet wire
8. 2x1 Female pin header/terminals
9. Conductive Wire glue
10. Strain gauge silhouette file
11. Silhouette grid cut file



TC1337 Remote Lab/Classroom

- 15 laptops
- Lan line connection
- 3 - 55" TVs
- Instructor PC
- Remote Lab Area
with 4 rack mounted PCs
- Common remote area

- Unique Classroom config
- Has computer that are on lan line
- Instructor has easy access to students
- 55" Monitors provide dual monitor
- Modifiable Remote Lab Area



Computing and Network

Remote Lab Area - Computing & Networking

Computing with USB interface

4 rack mounted PCs ~ 800 each

Monitor with keyboard mouse ~ 600

Rack ~ 600

Dell PowerEdge R230 - rack-mountable

Xeon E3-1220V6 3 GHz - 8 GB - 1 TB

\$806.66

Tripp Lite KVM Rack Console w/ 19" LCD in

1URM Steel Drawer w Cable Kit

\$627.88

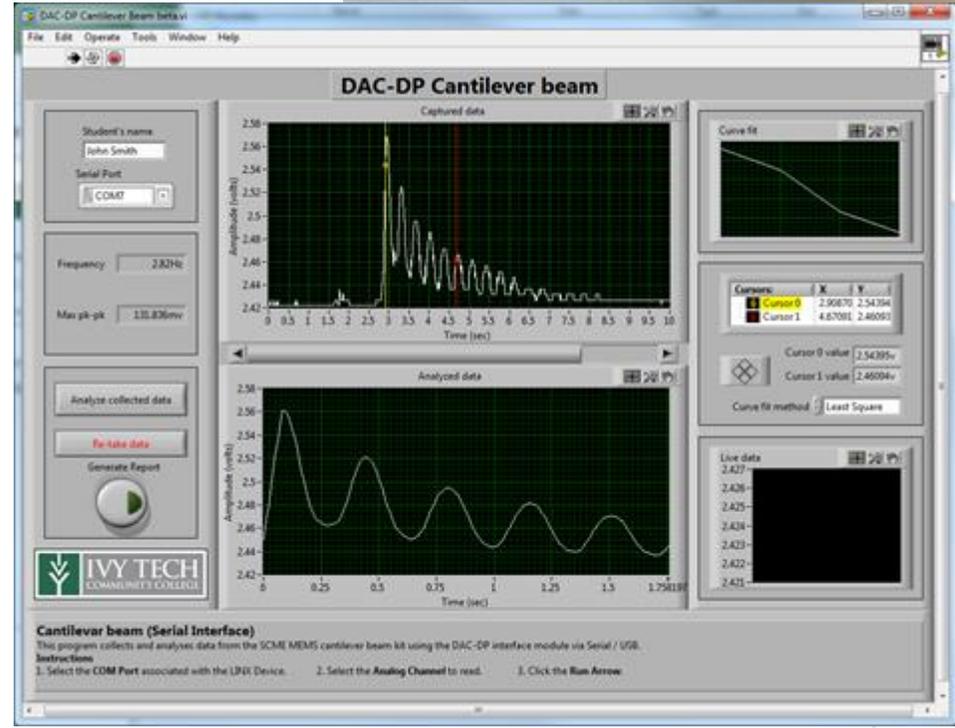
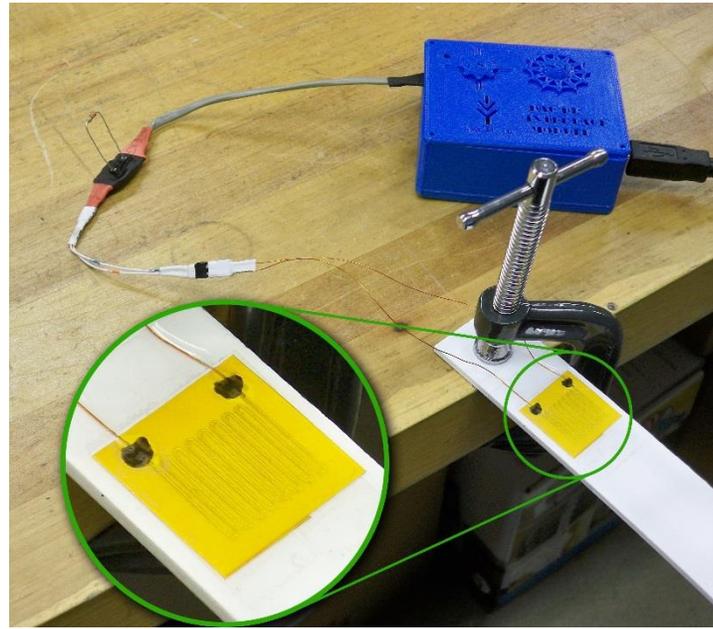
StarTech.com 22U 36in Knock Down Server

Rack Cabinet with Caster

\$607.12



SCME Cantilever Kit & Arduino Uno based DAK interface module, instruction manual, executable LabView Data acquisition software & USB cable



A Bit of Dynamic Theory¹

$$\omega_0 = \sqrt{\frac{k}{m}}$$

Natural Frequency

$$k = \frac{Et^3w}{4l^3}$$

Spring Constant

The natural frequency (ω_0) of a cantilever is related to its spring constant, k and mass, m . For a rectangular cantilever beam the spring constant (k) is a function of

E = *Young's modulus of Elasticity (a property of the material)*

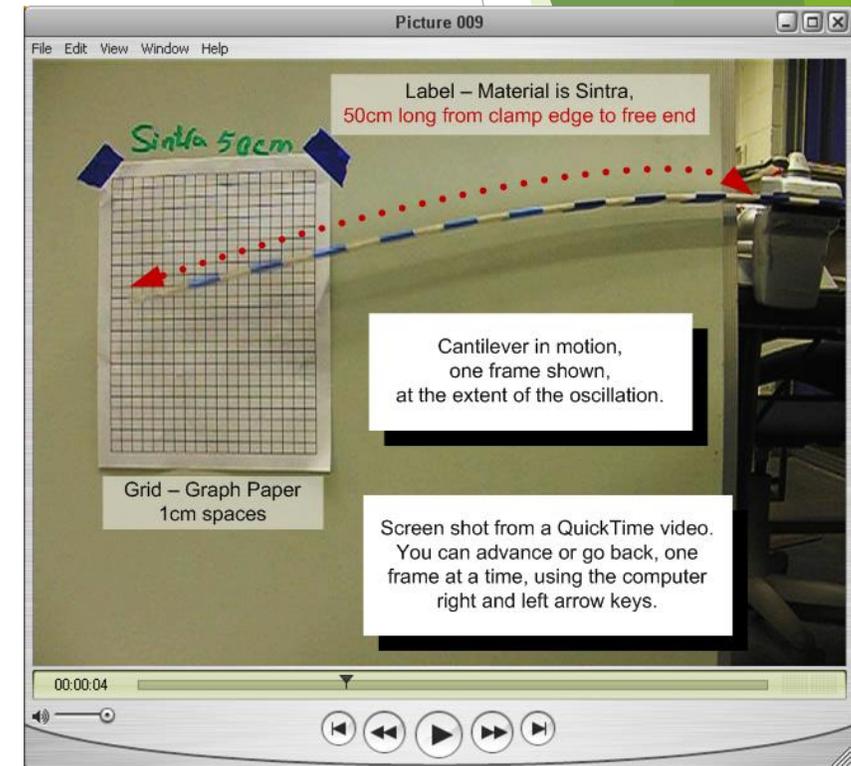
t = *thickness*

w = *width*

l = *length*

The Experiment

- Step 1 - Set up cantilever
- Step 2 - Set up camera
- Step 3 - Record cantilever specifications
- Step 4 - System Calibration
- Step 5 - Create a data table
- Step 6 - Record cantilever oscillations with no mass
- Step 7 - Record cantilever oscillations with added mass
- Step 8 - Determine the natural resonant frequency of the cantilever system
- Step 9 - Record your data
- Step 10 - Repeat steps 7 - 9
- Step 11 - Plot your data
- Step 12 - Complete the documentation requirements
- Step 13 - Answer all of the Post-Activity Questions and turn in with the report.



Link to BeyondTrust is <https://access.ivytech.edu/login/login>

Password7n\$Z*8ku7

Accounts:

fwlabguest

fwlabguest1

fwlabguest2

fwlabguest3

Link to remote lab info is http://www.ivytechengineering.com/remote_lab

Then please standby ...



Questions?



Questions?

<http://scme-support.org/>

<http://www.ivytech-mems.org/>

<http://www.ivytechengineering.com/abell118>

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