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

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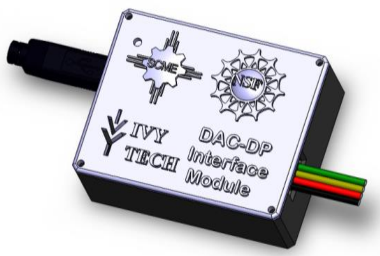
11/04/2020

SCME
Support Center for Microsystems Education

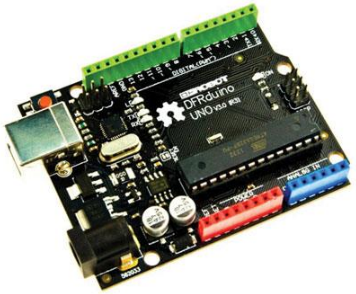
Using Arduino Uno and Labview in Teaching Natural Frequencies of SCME Microcantilevers Kits Workshop

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.

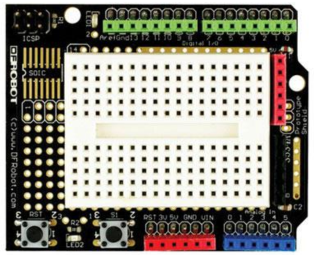


Arduino Uno

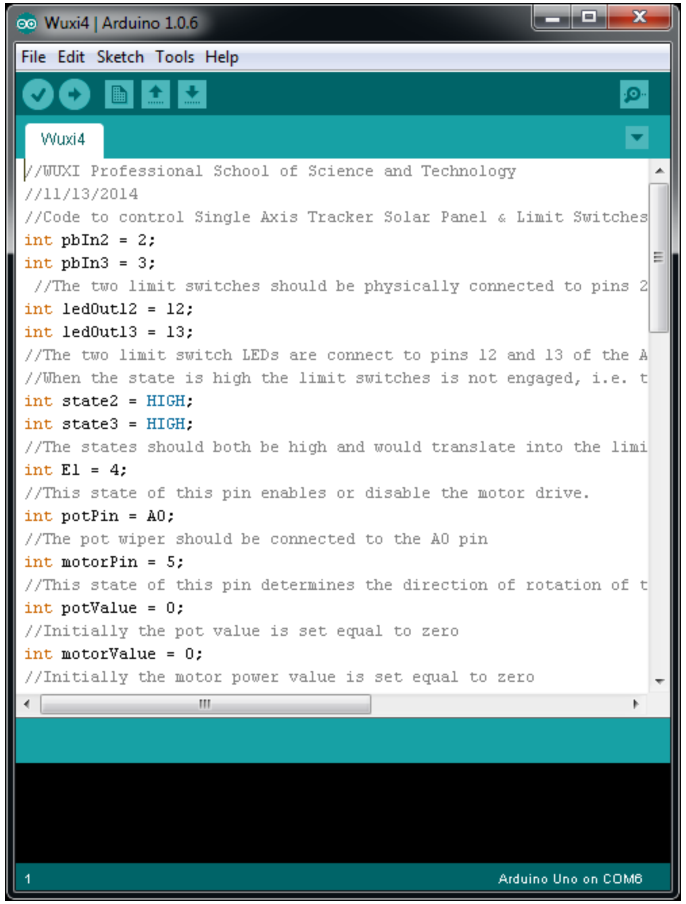
Specification	
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage	7-12V
Digital I/O Pins	14
Analog Input Pins	6
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
PC Interface	USB



Arduino Uno

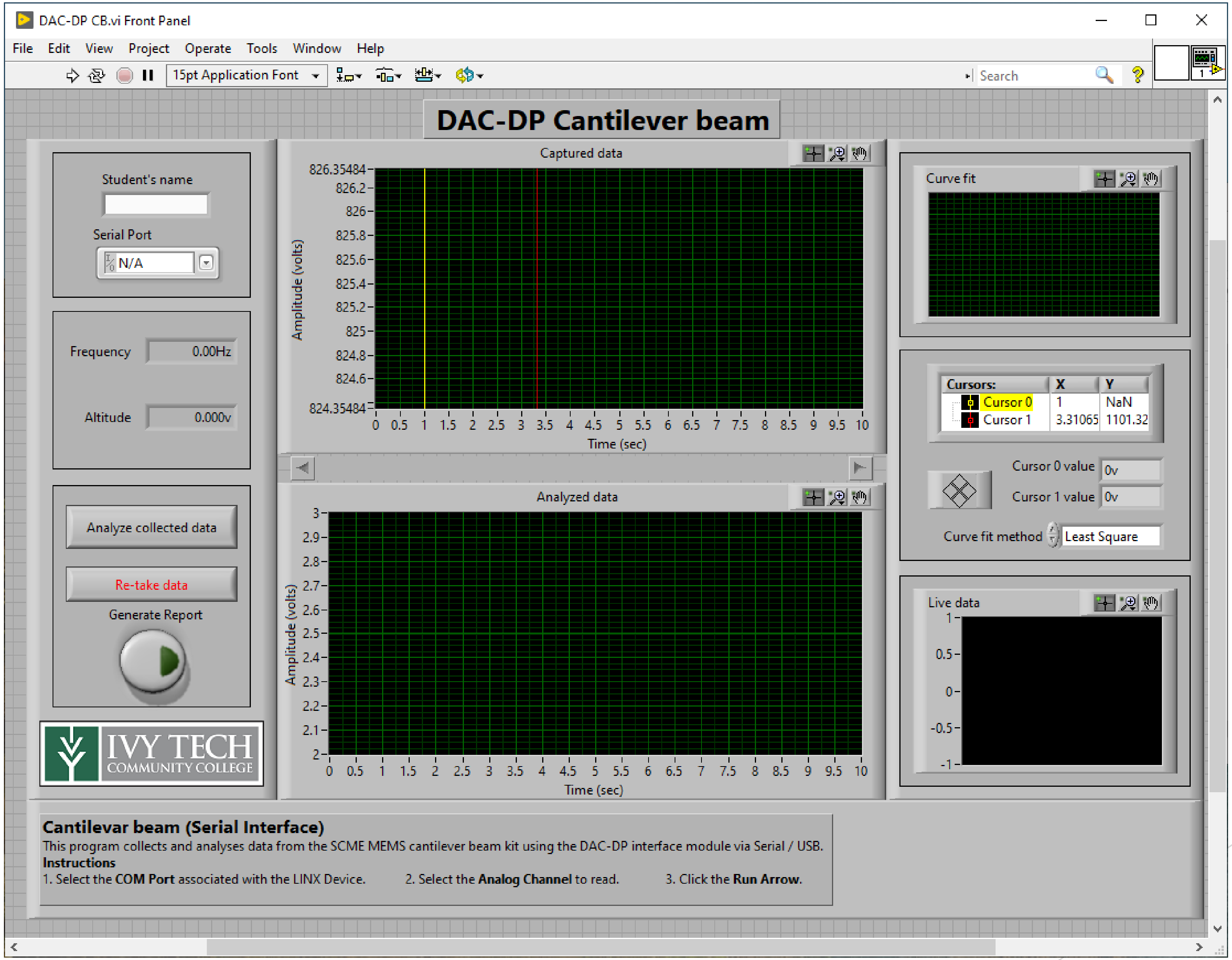


Prototype Shield

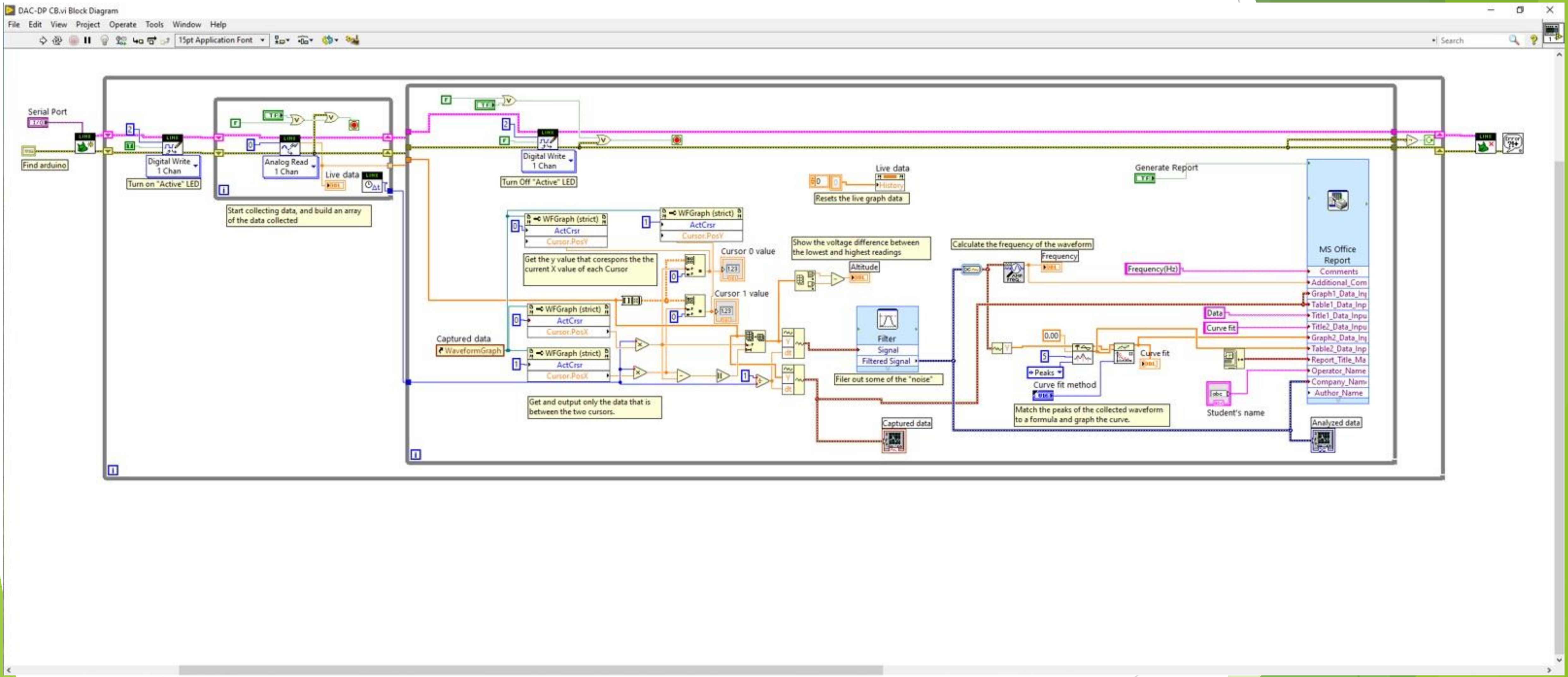


https://www.arduino.cc/en/Main/ArduinoBoardUno

The LabView code



The LabView code



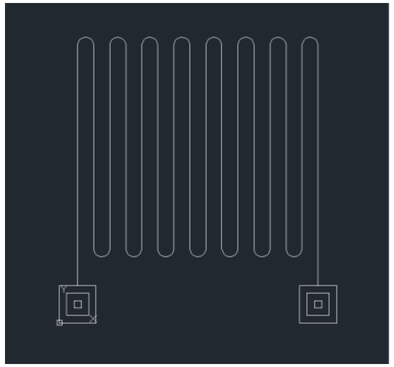
Strain Gauge Construction

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

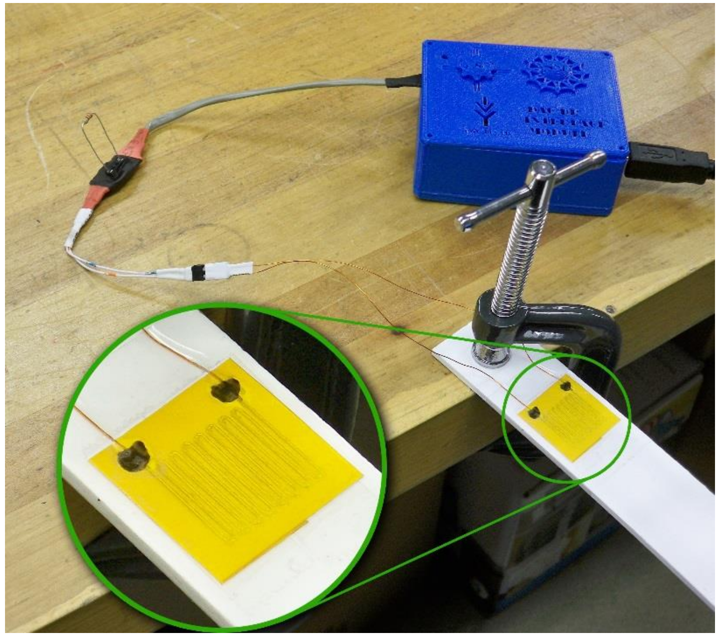
Computing with USB interface
4 rack mounted PCs ~ 800 each
Monitor with keyboard mouse ~ 600
Rack ~ 600

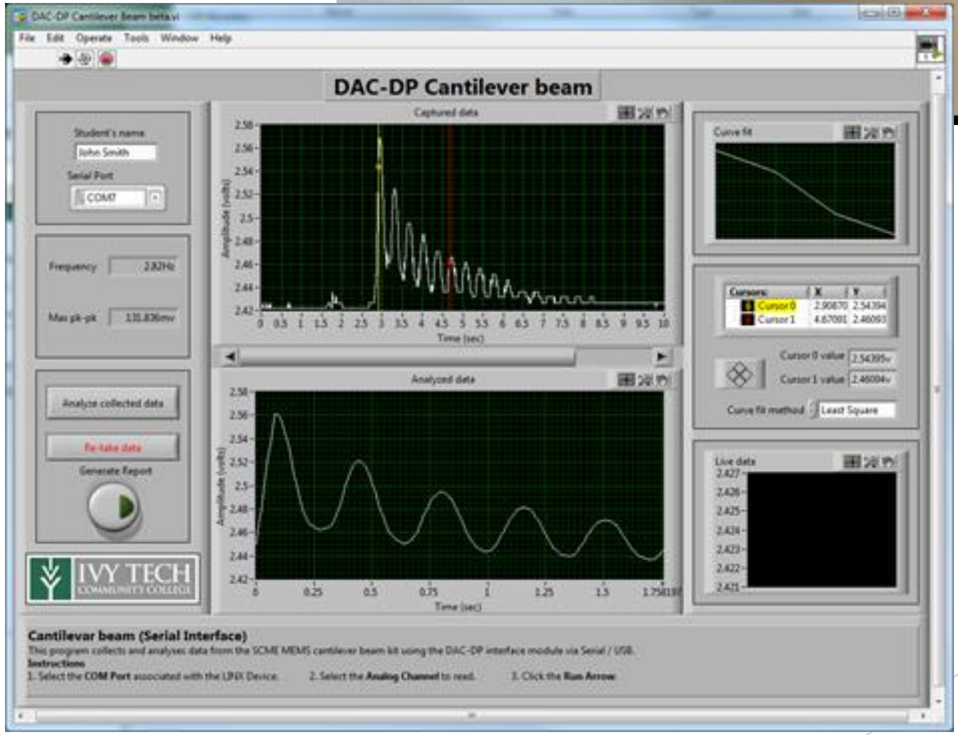
Dell PowerEdge R230 - rack-mountable
Xeon E3-1220V6 3 GHz - 8 GB - 1 TB
$806.66

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





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A Bit of Dynamic Theory[1]

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

Natural Frequency

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

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

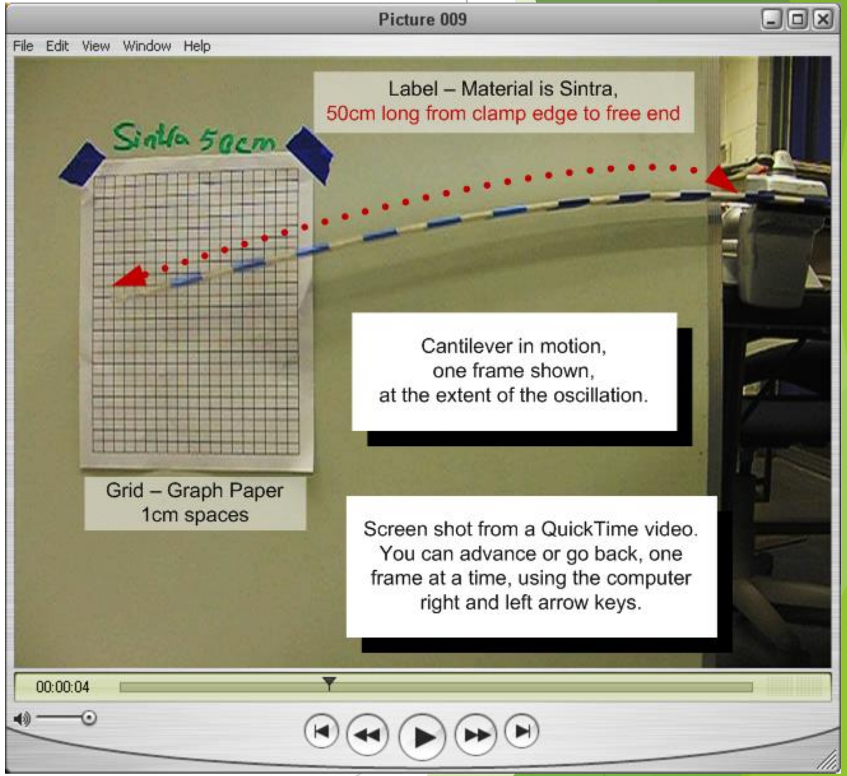
w = width

l = length

1 – SCME presentation on "HOW DOES A CANTILEVER WORK?"

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?

http://scme-support.org/
http://www.ivytech-mems.org/
http://www.ivytechengineering.com/abell118

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