



Data managing and archiving

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UCSD

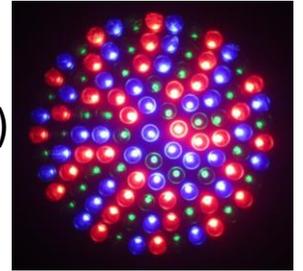
December 15th 2015



INTRODUCTION

Elide Pantoli

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L.E.D.(ay)



- Ph.D. candidate in Structural engineering at UCSD
- Worked on the BNCS project
- In charge of instrumentation (analog sensors) and uploading data from analog sensors on NEEShub

HISTORY OF EXPERIMENTAL DATA

From the seed of the idea to the sharing of knowledge



PHASE 1: **Brainstorming** phase: determining the goals



PHASE 2: Developing **instrumentation plans**



PHASE 3:
Installation of the sensors



PHASE 4:
Testing i.e. **Data collection**

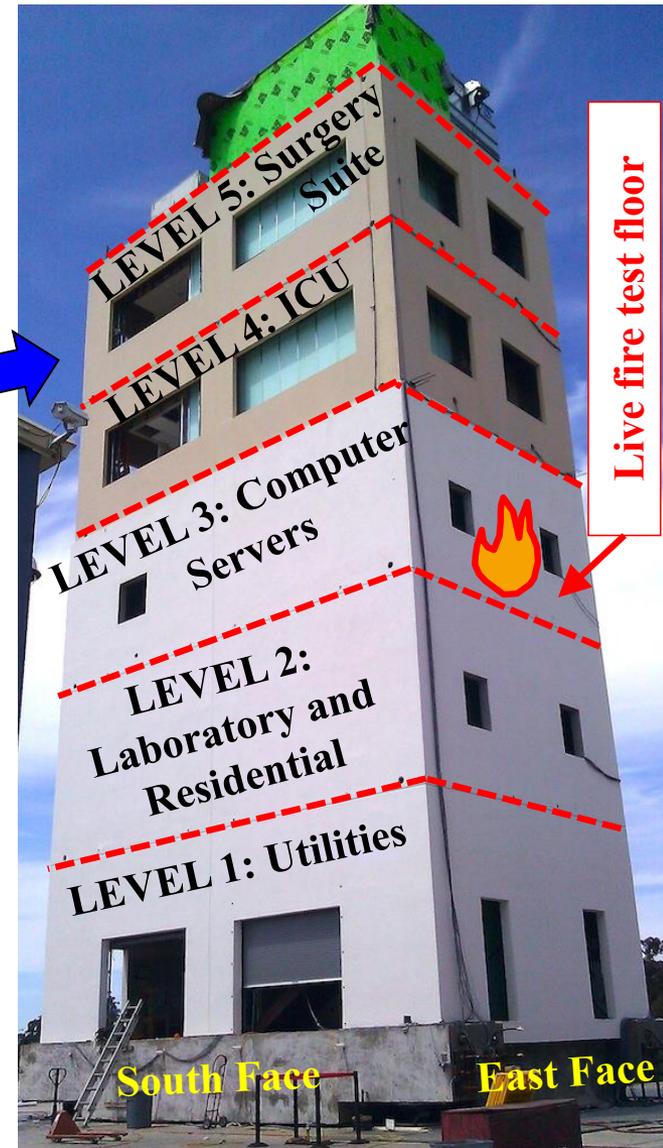
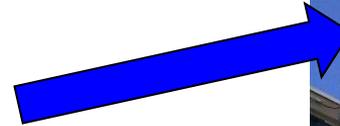


PHASE 5: **Data sharing**

HISTORY OF EXPERIMENTAL DATA

EXAMPLE: Precast concrete cladding panels installed on the BNCS building

Precast
Concrete
Cladding
Panels



Live fire test floor

South Face

East Face

PHASE 1: BRAINSTORMING

WHAT WE DO: Determine what are our **goals**, what information we want to obtain from the test. Related to the open issues in the field

WHO DOES IT: Group of **experts in the field** [academia + industry]

EXAMPLE for precast cladding panels:

Meeting between

- Professors (UCSD, SJSU)
- Industry representatives (Willis Construction, Clark Pacific)
- PCI advisor board

Determination of the goals: e.g. determination of the magnification of acceleration in the cladding panels, force in the connections, displacements relative to the building

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

WHAT WE DO: Starting from the goals, we determine how to measure it e.g. which sensors to use, how to installed them etc.

WHO DOES IT: Students and technicians (back and forth with Professors)

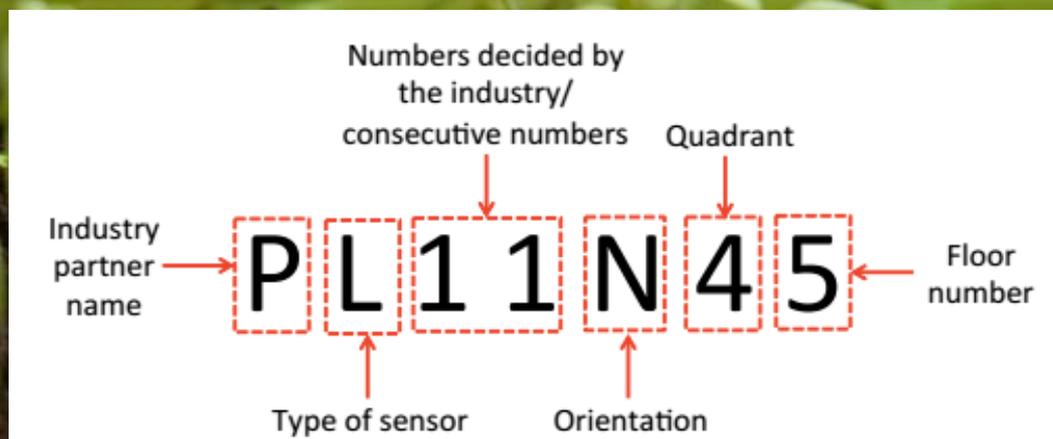
EXAMPLE for precast cladding panels:

Since we want to measure the magnification of accelerations, let's install sensors at mid height and top of the panels measuring the horizontal acceleration. Let's also measure the vertical acceleration at the two sides of the panel to see the effects of rocking! Let's do this in 2 panels located where we expect a larger response.

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

NOTE: Why is the name of sensors SO IMPORTANT (especially if many sensors are used)?

- It helps us identify the sensor during testing (if there are problems)
- It helps researchers navigate through data during data analysis phase



PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

Elide!!!! I took a look at the data and channel UA16U46 is not working!!!!

Let's fix it! This channel is from one of the UCLA (U) accelerometers (A) pointing upward (U) installed on the roof (6) in the North-East quadrant (4).

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

EDUCATIONAL PRODUCT

17'-0"

8'-1/2"

8'-1/2"

17'-0"

8'-1/2"

1'-11"

NEES4

BC3MX4R

BC3SX4R

NEES4

BC2MX4R

BC2SY4R

NEES4

BC3MY4R

BC3Y4R

NEES4

BC1MX4R

BC1SX4R

NEES4

BC4MX4R

BC4SY4R

NEES4

BC1MY4R

BC1Y4R

NEES4

BC4MY4R

BC4Y4R

NEES4

BC1AX4R

NEES4

BC4AX4R

Y axis

Z axis vertical (positive UP)

1.000

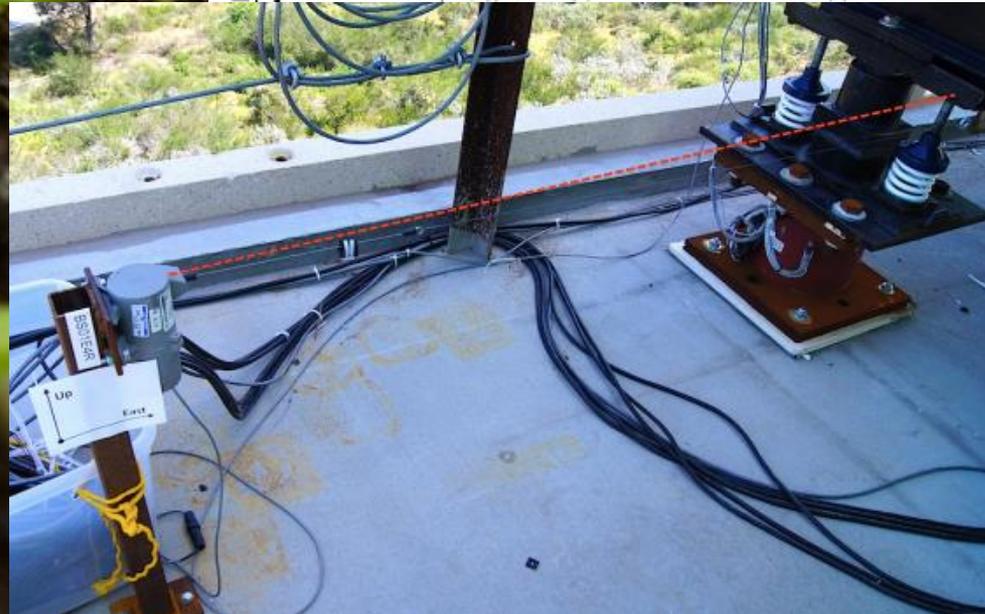
SCALE 1:60

ELIDE PANTOLI
Graduate Student Researcher
University of California, San Diego
MICHELLE CHEN
Graduate Student Researcher
University of California, San Diego

BNC-S Project
Subsystem: Cooling tower
Sensors type: Load cells
View: Plan view of roof

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



ADVICE: Work in close collaboration with the staff!!!

CC Image Courtesy of Lucy Crosbie on Flickr

PHASE 3: INSTALLATION OF SENSORS

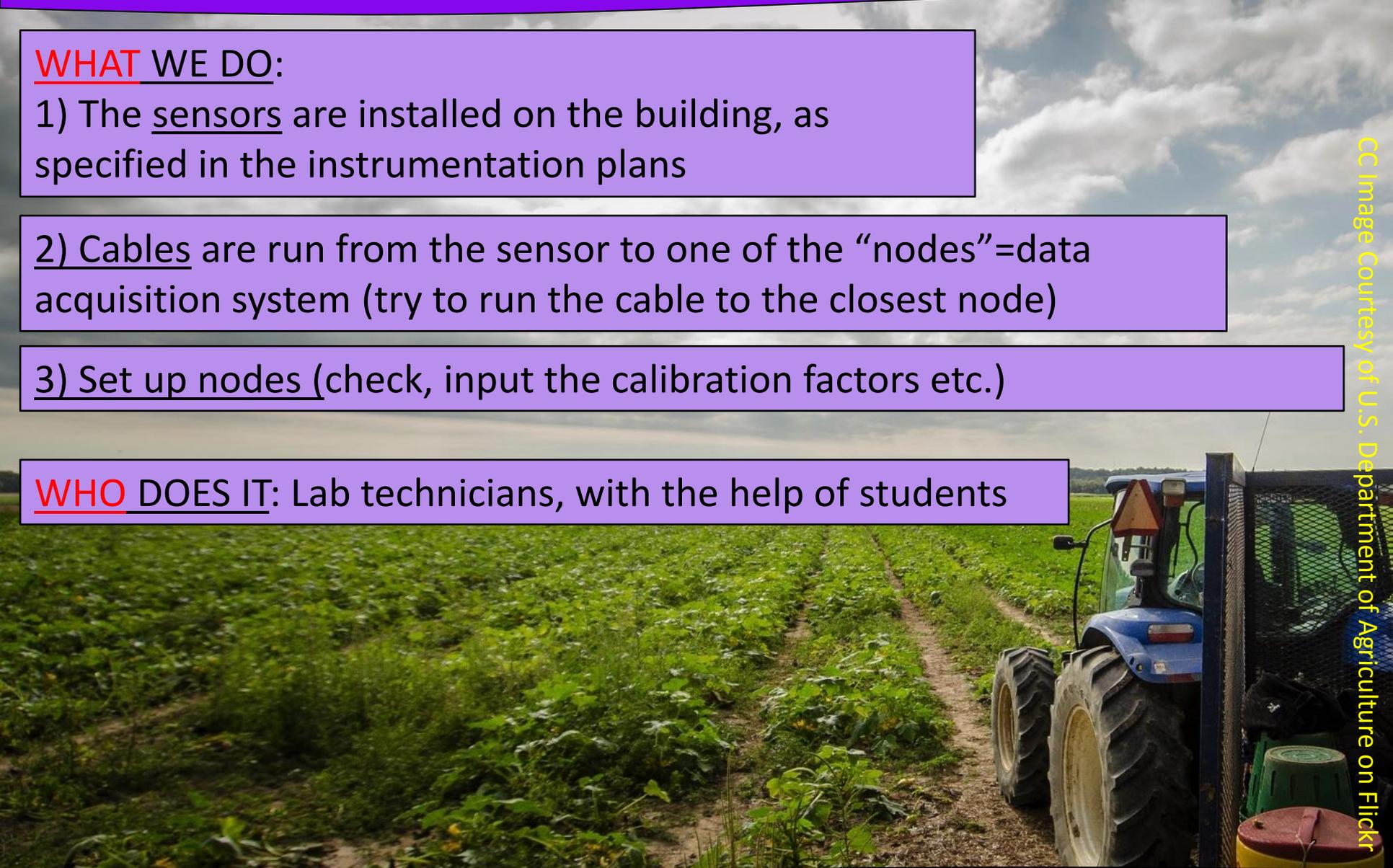
WHAT WE DO:

1) The sensors are installed on the building, as specified in the instrumentation plans

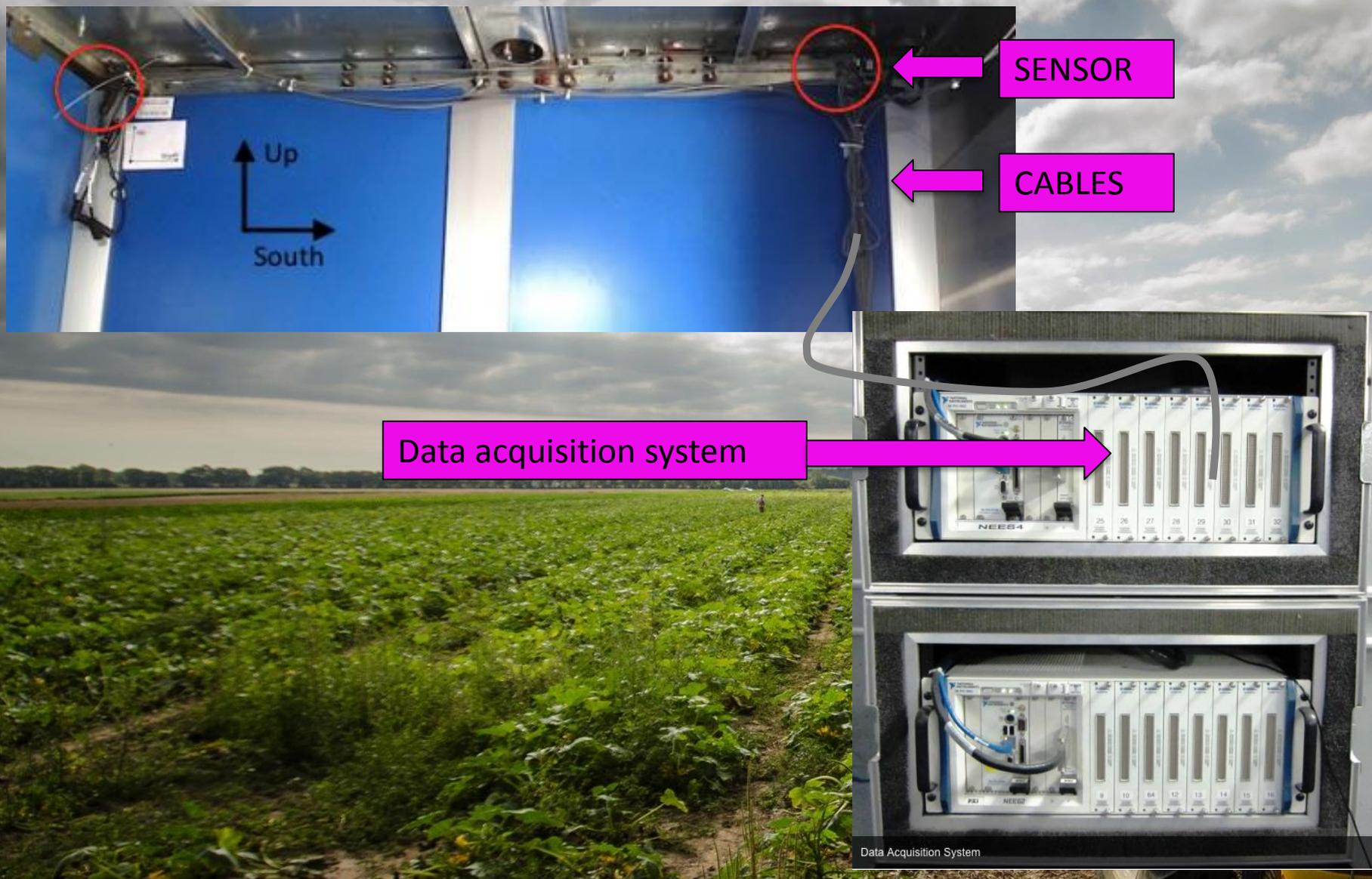
2) Cables are run from the sensor to one of the “nodes”=data acquisition system (try to run the cable to the closest node)

3) Set up nodes (check, input the calibration factors etc.)

WHO DOES IT: Lab technicians, with the help of students



PHASE 3: INSTALLATION OF SENSORS



SENSOR

CABLES

Data acquisition system

CC Image Courtesy of U.S. Department of Agriculture on Flickr

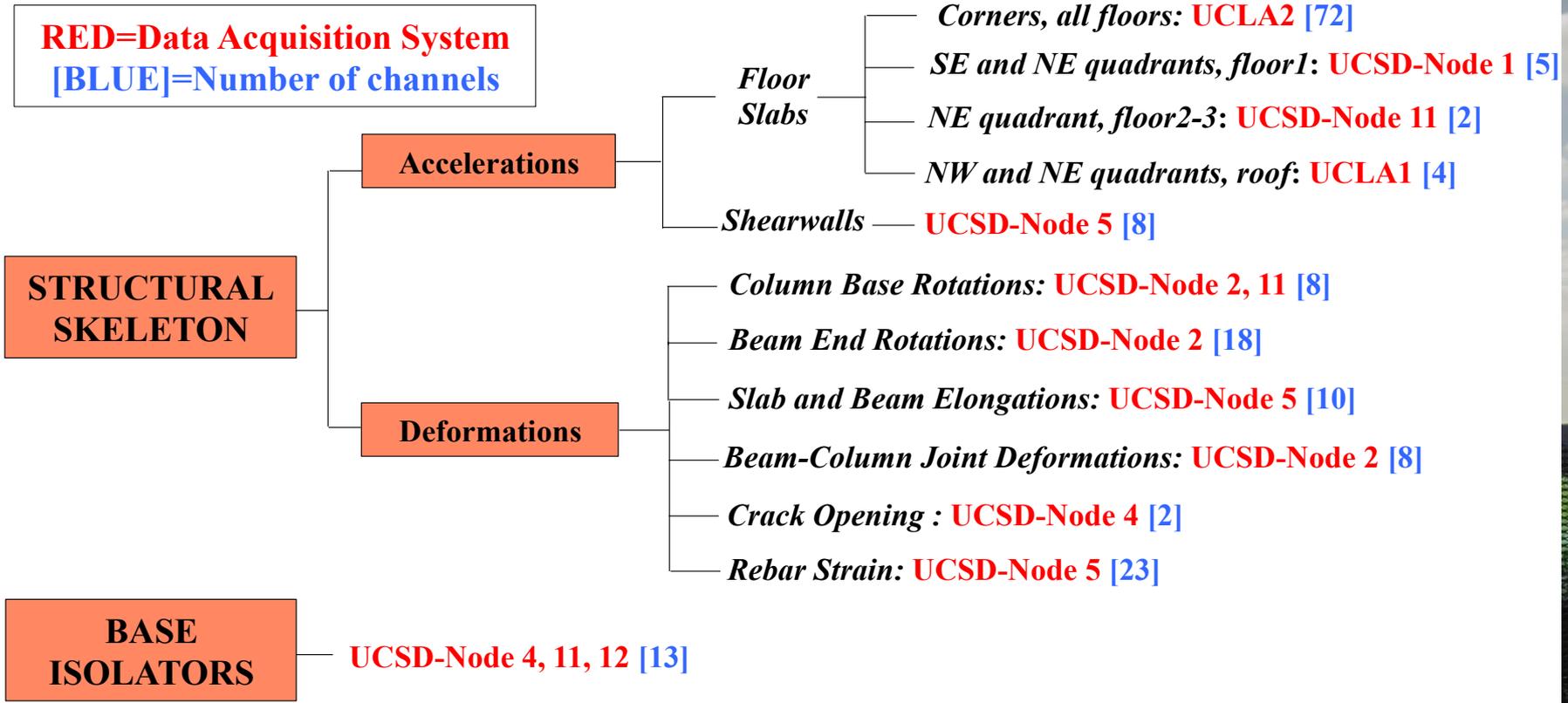
Data Acquisition System

PHASE 3: ISTALLATION OF SENSORS

Component	Number of sensors						Sum
	UCLA1	UCLA2	UCSD				
	A	A	A	DT	SG	LC	
Structural skeleton and isolators	4	72	17	57	23	-	173
NCSs	8	-	124	108	23	62	325
Shake table and basement	-	9	9	-	-	-	18
Sum	12	81	150	165	46	62	516

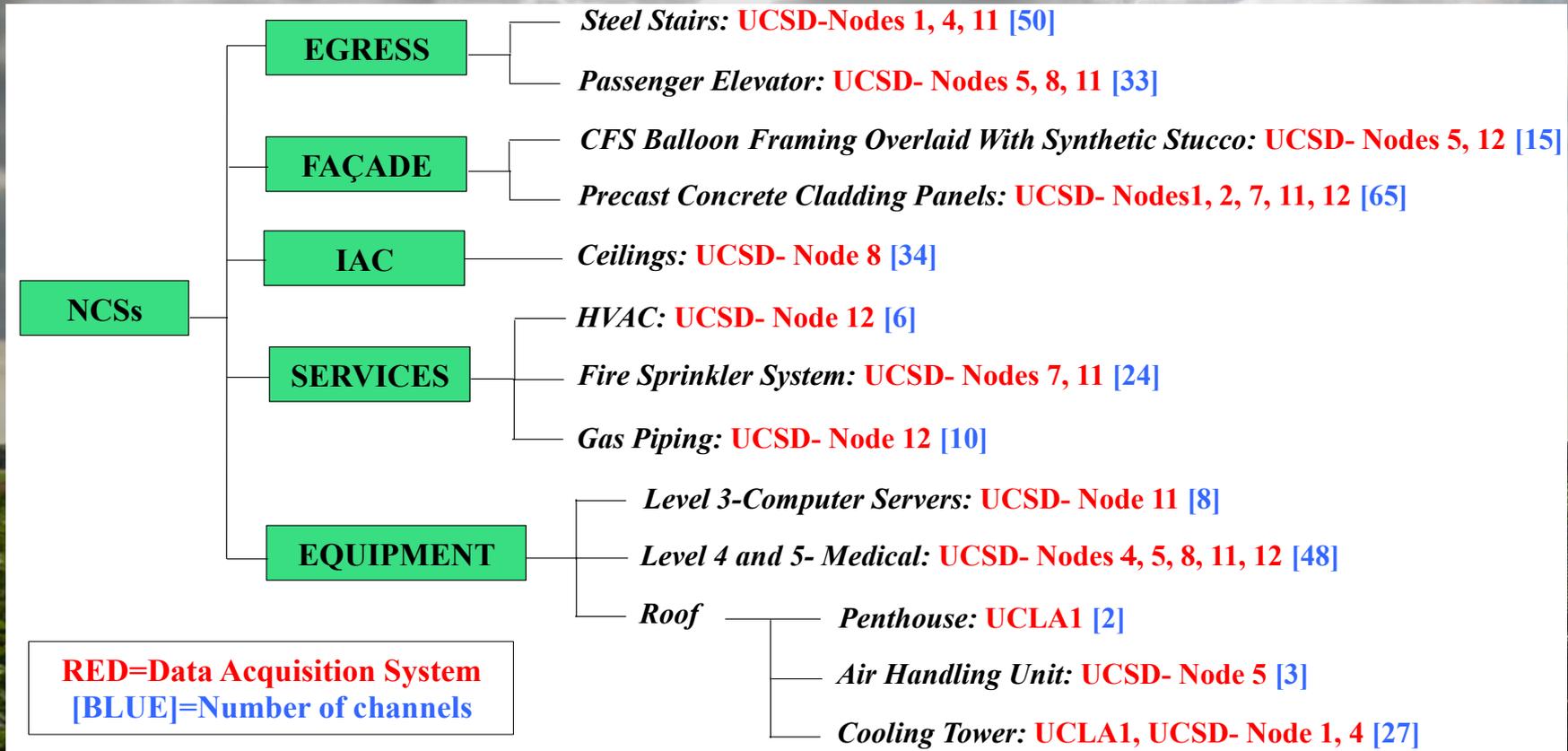
Note: A=Accelerometers; DT=Displacement Transducers; SG=Strain Gauges; LC=Load Cells

PHASE 3: INSTALLATION OF SENSORS



CC Image Courtesy of U.S. Department of Agriculture on Flickr

PHASE 3: INSTALLATION OF SENSORS



PHASE 4: TESTING a.k.a. DATA COLLECTION

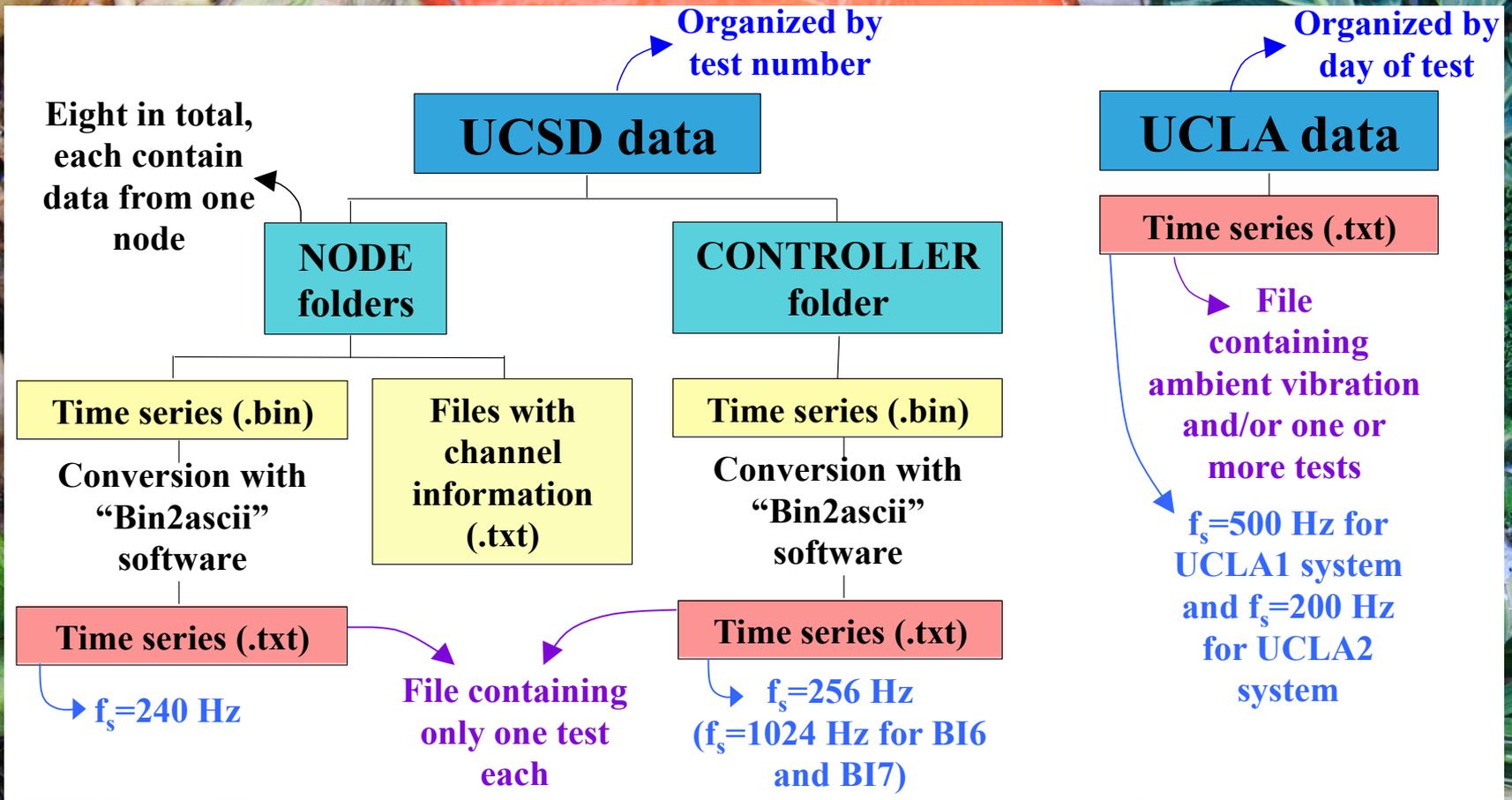
WHAT WE DO:

Data are recorded during testing

WHO DOES IT: Whole team

- Data format: Students are generally provided with text files that can be opened in excel.
- Each column contains the time history of data recorded by a particular sensor
- Relevance of metadata: extra information that we need (example: units, sampling time etc.)
- Data from different DAQs can be formatted slightly differently (but key information must be present)

PHASE 4: TESTING a.k.a. DATA COLLECTION



Synchronization in time of the sensors → Manually

PHASE 4: TESTING a.k.a. DATA COLLECTION

NEES@UCLA Format:

Column #1	Column #2	Column #3
* .. , * ... **): :: :	-14+9. : +'	6, (: 1'
* .. , * ... *1)44('	-14+++ . : '	6+, +: '
* .. , * ... *1)44: '	-14+1(: 6'	6+9*6'
* .. , * ... *1)4*('	-14+.. +9'	6+, 6: '
* .. , * ... *1)4*:'	-14+(+46'	6, *: 6'
* .. , * ... *1)41('	-14+*9, 1'	6, ++4'
* .. , * ... *1)41: '	-14+1*. 9'	69446'
⋮	⋮	⋮
⋮	⋮	⋮
⋮	⋮	⋮

Unix time
Time Series, Channel 1
Time Series, Channel 2

No headers in this case! Separate file telling us which channel was in each column

NOTE: in this case the calibration factors were NOT applied! Calibration factors provided in a separate file for each channel

PHASE 4: TESTING a.k.a. DATA COLLECTION

BNCS NEESR Project
Sensor Table
 Rev. 7, 3/17/2012 R. Nigbor/A. Salamanca



System UCLA2: 84-channel Q330 Array

- Notes:**
- 200sps per channel, linear phase filter
 - Rockhound system, triggered
 - ASCII data format w/time column

KEY:

Reversed polarity
No Tilt Test
Not installed yet
Some electr. noise

Start Date: 3/6/12 **Stop Date:** xxx

Data Channel	Rockhound DIG#	Q330	Q330 Channel	Measurement Type	Manufacturer	Model	S/N	Sensor Axis	Global Orientation (X-East)	Level	Quadrant	Channel Code	Coordinates,ft			Cable No.	Data file units	Channel Sensitivity g/count	Calibration K (Volts/g)
													X	Y	Z				
1	dig1	273A	1	Acceleration	Kinometrics	ES-U	543	k	Z	6	1	UA11U16	-17	-10	75	C4-1	counts	4.8068E-07	4.96
2			2	Acceleration	Kinometrics	ES-U	539	j	Y	6	1	UA11N16	-17	-10	75	C4-2	counts	4.7779E-07	4.99
3			3	Acceleration	Kinometrics	ES-U	532	i	X	6	1	UA11E16	-17	-10	75	C4-3	counts	4.7684E-07	5.00
4		273B	4	Acceleration	Kinometrics		1446	k	Z	6	2	UA12U26	17	-10	75	T17	counts	4.7779E-07	4.99
5			5	Acceleration	Kinometrics	ES-T	1446	j	Y	6	2	UA12N26	17	-10	75		counts	4.7827E-07	4.99
6			6	Acceleration	Kinometrics		1446	i	X	6	2	UA12E26	17	-10	75		counts	4.7875E-07	4.98
7	dig2	274A	1	Acceleration	Kinometrics	ES-U	545	k	Z	6	3	UA13U36	-17	10	75	C7-1	counts	4.7684E-07	5.00
8			2	Acceleration	Kinometrics	ES-U	541	j	Y	6	3	UA13N36	-17	10	75	C7-2	counts	4.7589E-07	5.01
9			3	Acceleration	Kinometrics	ES-U	586	i	X	6	3	UA13E36	-17	10	75	C7-3	counts	4.7684E-07	5.00
10		274B	4	Acceleration	Kinometrics		1702	k	Z	6	4	UA14U46	17	10	75	T16	counts	4.7779E-07	4.99
11			5	Acceleration	Kinometrics	ES-T	1702	j	Y	6	4	UA14N46	17	10	75		counts	4.7827E-07	4.99
12			6	Acceleration	Kinometrics		1702	i	X	6	4	UA14E36	17	10	75		counts	4.7875E-07	4.98

↑
 Column# in excel file

↑
 Sensor name

↑
 Calibration factor (from count to engineering units)

Some initial work to get the data ready for use, but once they are ready no need to deal with this anymore!

UCLA metadata file

CC Image Courtesy of Hans Splinter on Flickr

PHASE 5: SHARING OF THE DATA

WHAT WE DO:

Data are uploaded on NEEShub and shared with the community

WHO DOES IT: Students

The screenshot shows the NEEShub website interface. At the top, there is a navigation bar with links for 'About NEES', 'Tools & Resources', 'Learning & Outreach', 'Project Warehouse', 'Simulation', 'Sites', 'Collaborate', 'Explore NEEShub', and 'Support'. Below the navigation bar, the breadcrumb trail reads 'You are here: Home » Project Warehouse » NEES-2009-0722'. The main content area is titled 'NEES Project Warehouse' and features a project entry for 'NEESR-CR: Full-Scale Structural and Nonstructural Building System Performance during Earthquakes'. The project entry includes a 'Review This Project' link and an 'OPEN DATA' button. Below the project title, there are tabs for 'Project', 'Experiments', 'Team Members', 'File Browser', and 'Reviews'. A search bar labeled 'warehouse search' is also present. The project details section includes an 'Executive Summary' with a 'Download Document' link, 'PI(s): Tara Hutchinson, Joel P Conte, Jose Restrepo', 'Dates: October 01, 2009 - September 30, 2014', 'Facility: University of California, Los Angeles, CA, United States; University of California, San Diego, CA, United States', 'Organization(s): University of California, San Diego, CA, United States', 'Description: This landmark project involved earthquake and post-earthquake live fire testing of a five-story building constructed at full-scale on the NEES@UCSD outdoor shake table. Unique to previous full-scale building test programs, the structure was completely... (more)', 'Sponsor: NSF - CMMI - 0936505 (view)', and 'Website(s): https://ucsd.bncs.edu (view)'. A small image of a building is shown with the caption 'This landmark project involved...'. To the right of the image, there are statistics: '3140 Views' and '10162 Downloads'. At the bottom right, there is an 'Edit this project' button.

CC Image Courtesy of Rick on Flickr

PHASE 5: SHARING OF THE DATA

WHAT WE DO:

Data are uploaded on NEEShub and share with the community

WHO DOES IT: Students

Experiment-1: Shake table testing of a five story building outfitted with NCSs (BNCS project)

Trial 1: 04/16/2012

Trial 8: 05/15/2012

Documentation

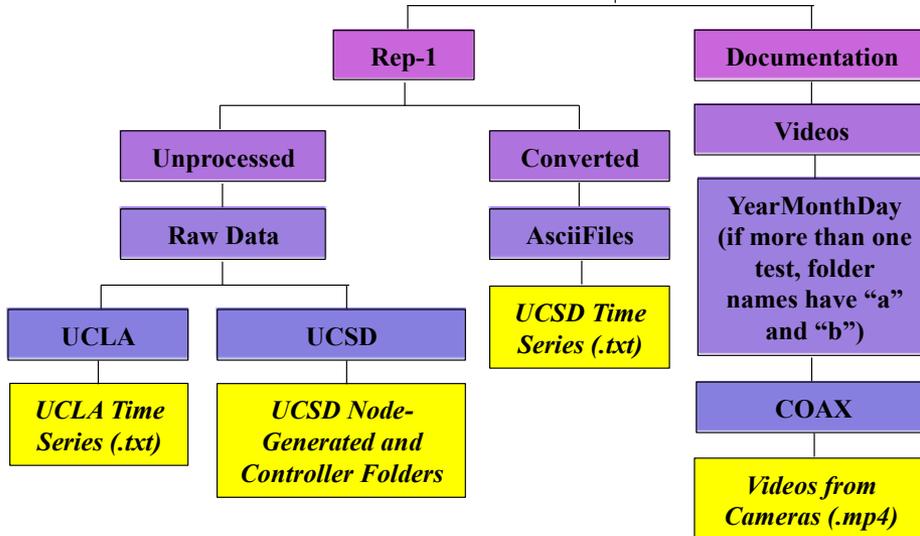
Photos

Construction

Testing

*Construction
Pictures
Organized by
Photographer
Name and Date*

*Testing
Pictures
Organized by
Photographer
Name and Date*



FINAL NOTE: it's not just about analog sensors!

VERY IMPORTANT
to check the
displacement
obtained with
double integration
of accelerations

Follow general
rules when
taking pictures
(makes sure you
know where you
are, you have a
clean shot etc.)

VIDEO CAMERAS

Provided by
industry partners
and by
NEES@UCSD



ANALOG SENSORS

Three DAQs provided by
NEES@UCSD and NEES@UCLA
(UCLA1 and UCLA2)



GPS

Provided by
the Scripps
Institute of
Oceanography



STILL CAMERAS

High resolution digital
images were taken
during construction and
testing by the research
team and industry
partners



FINAL NOTE: video cameras



Typical Image of Camera	Number of Cameras	Approximate Uncut Data Collected (GB)	General Purpose	Sample Snapshot of Camera View
	56	~140	Capture visual data within the structure with input from industry partners – emphasis on NCSs	
	16	~43	Capture visual data within the structure – emphasis on NCSs	
	8	~215	Capture overall views and external visual data	
	7	~200	Capture visual data within the structure for fixed base testing emphasis on structural components	

IP

Coax

High definition camcorder

GoPro

CC Image Courtesy of Rick on Flickr

FINAL NOTE: video cameras



(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)

CC Image Courtesy of Rick on Flickr

FINAL NOTE: video cameras

CONSIDERATIONS

◆ GOPROS

- BATTERY LIFE
- SYNCHRONIZATION WITH EACH OTHER AND WITH DATA
- DISTORTION
- LARGE VIDEO FILES
- VIBRATION (EASY TO STABILIZE BC OF LIGHT WEIGHT)

◆ IP/COAX CAMERAS

- VIDEO QUALITY
- DROPPED “PACKAGES” (DROPPED FRAMES)
 - SYNCHRONIZATION ISSUES FROM THIS
 - LIMITATIONS ON # OF CAMERAS
- LONG CABLES
- VIBRATION – MOUNTING BRACKET MUST BE STABLE

◆ CAMCORDERS

- BATTERY LIFE
- VIBRATION
- SYNCHRONIZATION
- LARGE FILES
- MANUAL START/STOP