

Alternatives in the Implementation of Internet-Enabled Laboratory Experiments in Undergraduate Civil Engineering Courses

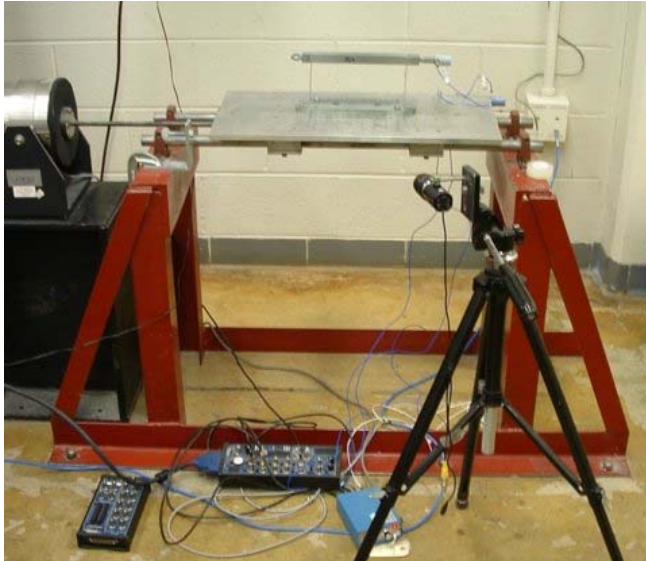
Abhinav Gupta, Mo Gabr and Vernon C. Matzen

2004 ASEE Annual Conference

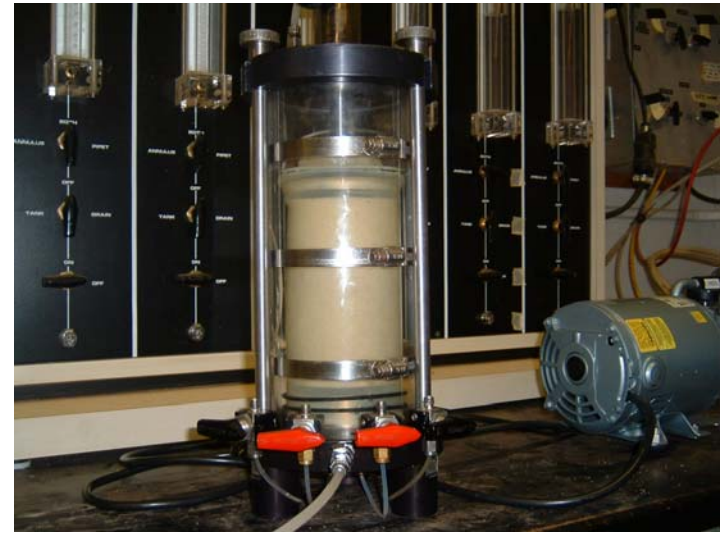
Objectives:

- Convert two Civil Engineering undergraduate lab experiments, one using a shake table the other using a triaxial compression test on soils, to web-based remote *control*, *data recovery* and *observation* for Distance Learning applications.
- Protect against *intentional* or *unintentional damage* to test facility or specimens.

Experimental setups:



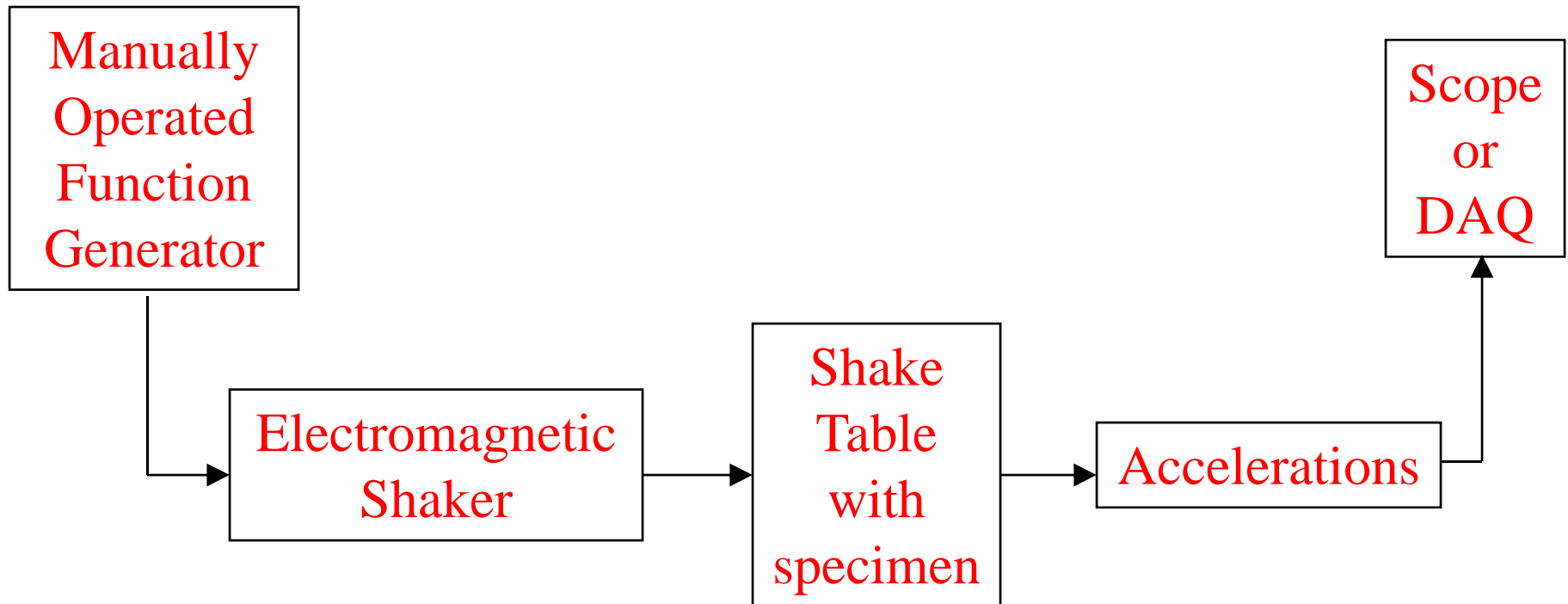
Shake Table Test



**Triaxial
Compression
Soil Test**

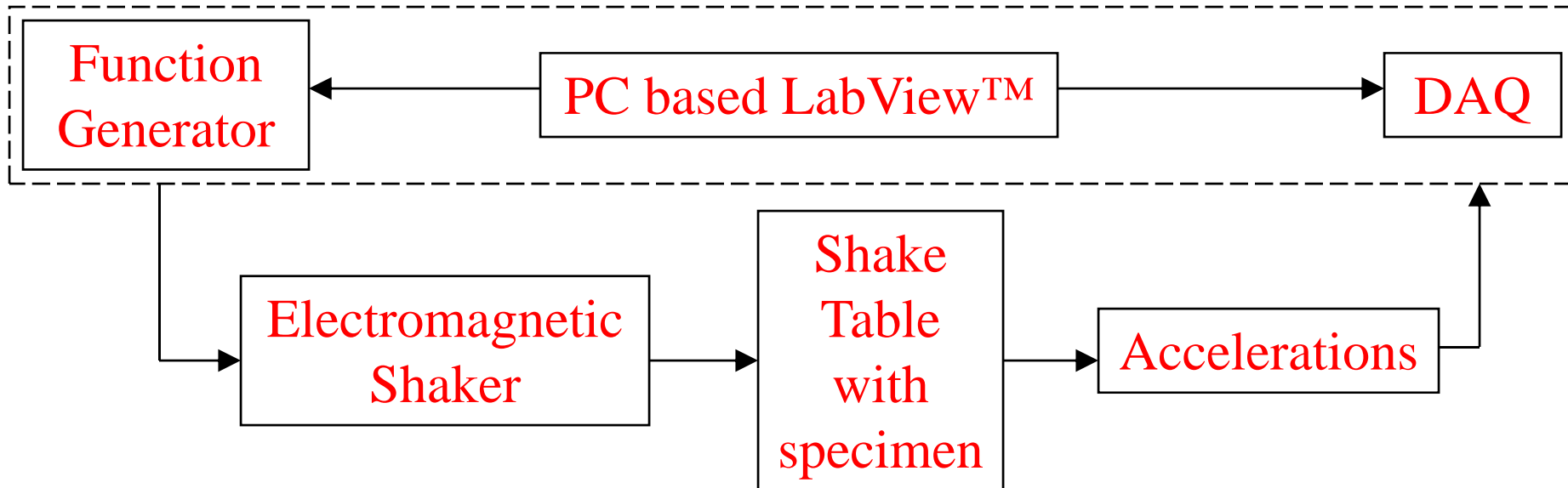
Shake Table Example:

- Onsite manual configuration



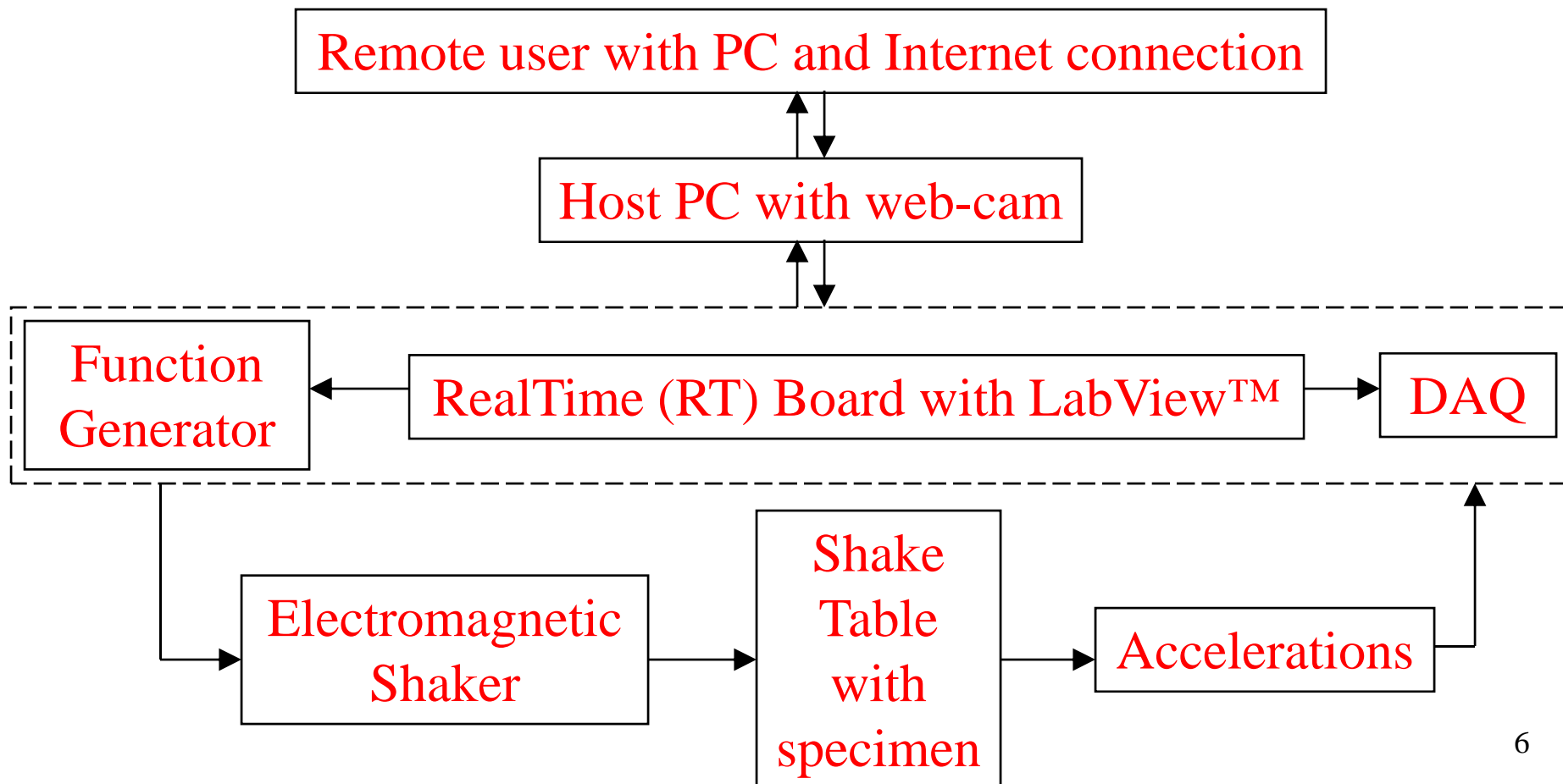
Shake Table Example :

- Onsite LabView™ configuration



Shake Table Example :

- Remote LabView™ configuration



Alternatives:

1. Experiments

- Shake table test
- Triaxial compression soil test

2. Enabling software and hardware

- **Shake table:** National Instruments PXI chassis and LabViewRT™
- **Soils test:** Netmeeting with Digiflow-GP and Sigma 1-CU

3. Internet protocols

- **Shake table:** TCP/IP, remote front panels
- **Soils test:** NetMeeting

Alternatives (cont'd):

4. Operator/viewer options
 - single operator with download privileges - multiple viewers
 - Single operator – multiple viewers with download privileges
5. Security procedures
 - **Shake table:** administrative override on Host Computer; password protected access to experiment; RT board for direct control of experiment; Proxy server (coming)
 - **Soils test:** not yet addressed

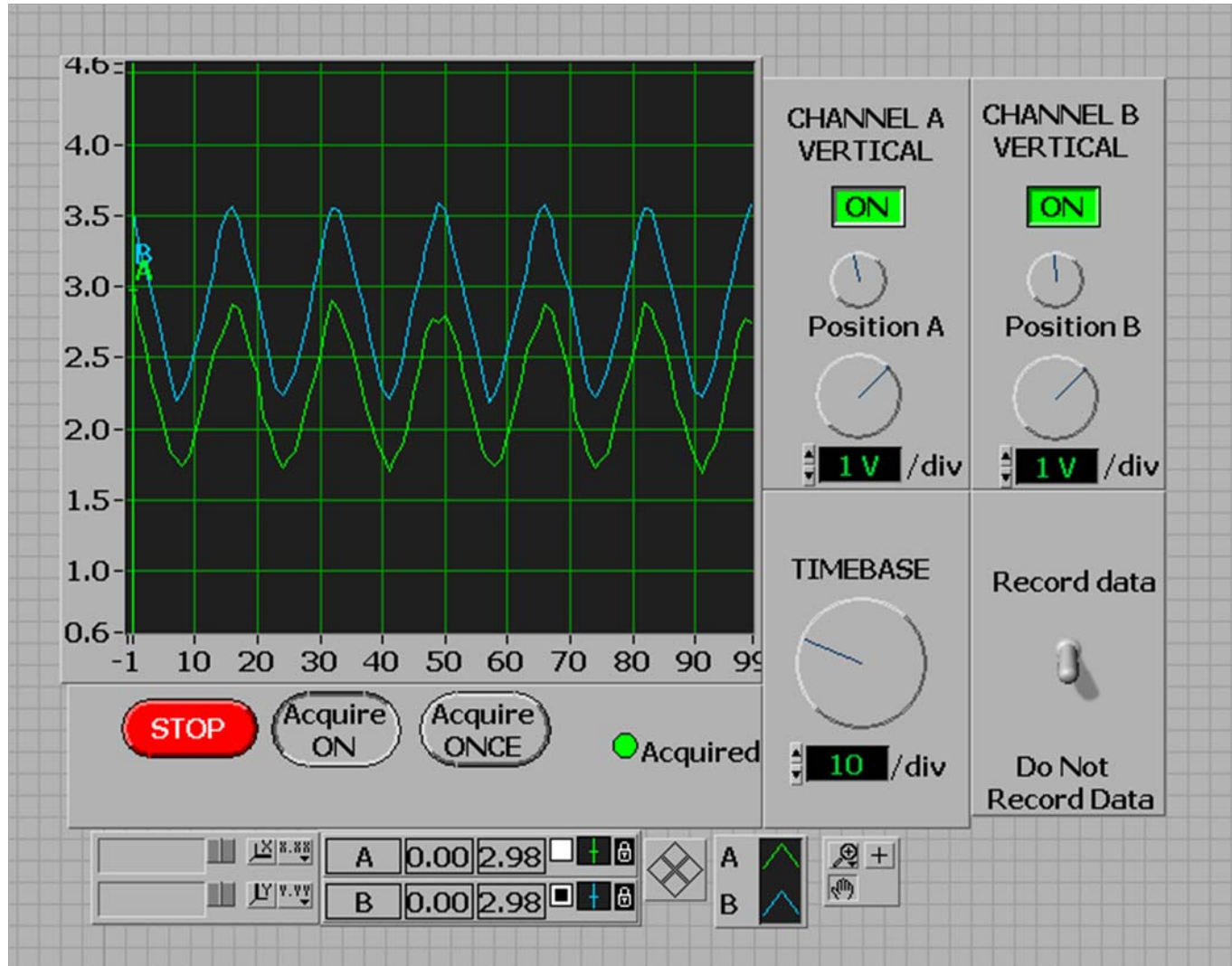
Alternatives (cont'd):

6. Safe shutdown procedures
 - **Shake table:** RT board and handshaking vi to handle system and network crashes
 - **Soil test:** not yet addressed
7. Safety procedures
 - **Shake table:** administrator-specified limits on input and output parameters
 - **Soil test:** not yet addressed

Shake Table Example:

Select Waveform <input type="text" value="Sine"/>	Frequency <input type="text" value="3.00"/>	<input type="button" value="STOP"/>
Waveform Timelength (in seconds) <input type="text" value="10"/>	Amplitude <input type="text" value="3.00"/>	<input type="button" value="SEND"/>

Shake Table Example:



Shake Table Example:



Conclusions:

1. Netmeeting works well for the remote control and observation of experiments with equipment-specific control software but security, stability and safety issues need to be addressed.
2. LabView works well for the direct observation and control of experiments (it presumably also can be applied with equipment-specific control software).
3. LabView can easily handle stability issues.
4. LabView provides the flexibility to implement administrator-defined security features.
5. Safety can be addressed by limited input and output parameters.

References:

1. S. Wirgau, A. Gupta and V. Matzen, “Remote Observation and Control of a Shake Table Experiment.” Submitted to the ASCE Journal of Computing in Civil Engineering.
2. V. C. Matzen, S. Wirgau and A. Gupta, “Remote Observation and Control of a Shake Table Experiment.” Presented at the 2003 Annual ASEE Conference and Exposition in Nashville.
3. S. Wirgau, “Remote Observation and Control of a Shake Table Experiment.” MS Thesis. 2003. NCSU

Acknowledgements

The authors would like to acknowledge the support of the following:

NSF – CCLI program (DUE-0310845)

NCSU DELTA program

NCSU EngineeringOnline

Graduate Students Prakash Kripakaran,
Tanya Kunberger, Rakesh Saigal and
Scott Wirgau