

Rope Testing and Wear: Equipment of the CMT Data acquisition and elaboration

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Summary

- ❖ Equipment for rope testing
 - Dodero at the University of Padova
 - Machine for static tests
 - Dodero at the "Torre S. Lazzaro"
- ❖ Signal acquisition
- ❖ Conclusions

Main equipment

- ❖ University of Padova:
 - Dodero
 - Machine for "semi-static" tests
 - "Artificial wear" machine
- ❖ Torre S. Lazzaro (Padua):
 - Dodero machine (non validated)
 - Flexible and reconfigurable apparatus for experimentations and demonstrations on the security chain

Dodero

- ❖ Located in the Laboratory of Civil Engineering of the University of Padua
- ❖ Recently, it has been redesigned and improved:
 - Mechanical redesign
 - Instrumentation for data acquisition

Dodero - Data acquisition

- ❖ Need of measuring the forces generated during the fall of the mass (UIAA-EC norms)
- ❖ More accurate and detailed energetic analysis require other information on the mechanism and dynamics of the fall
- ❖ The data acquired in real time need to be available on computing facilities for further studies and analyses

Dodero - Data acquisition

It is possible to measure (digitally):

- ❖ Forces (load cell)
- ❖ Position/velocities (laser)
- ❖ Acceleration (acceleration sensor)

of the falling mass and to save the data
acquired in real time on a PC

Load Cell

- ❖ Full bridge load cell
- ❖ Sensitivity: 2 mV/V
- ❖ Maximum load: 5000 daN
- ❖ Input voltage: 0.5 ... 12 V



Laser Sensor LE 100-SSI

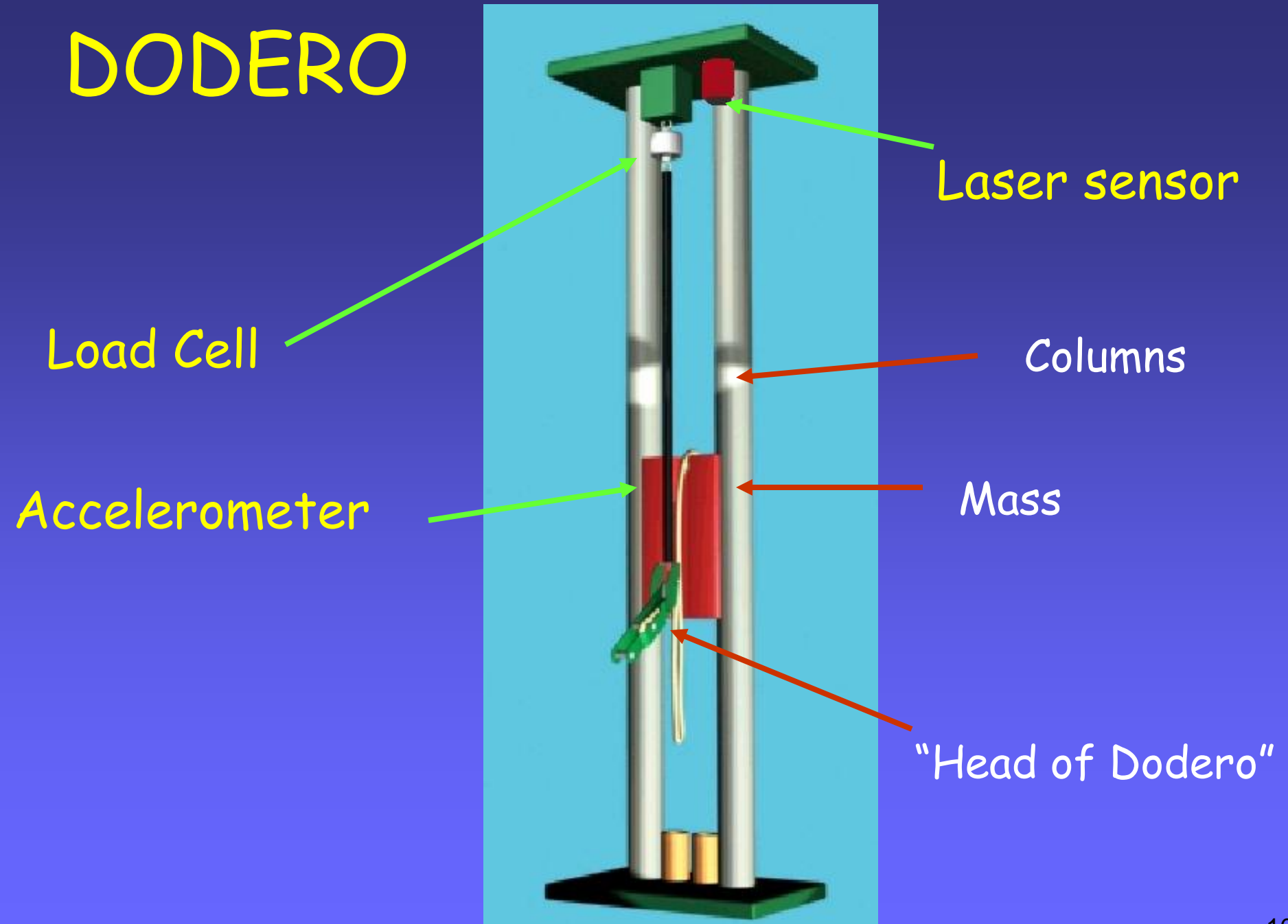
- ❖ Range: 0.2 - 100 m
- ❖ Resolution: 1 mm
- ❖ Digital output (binary/gray)
- ❖ Programmable (SW)



Accelerometer

- ❖ Range: $\pm 50g$
- ❖ Analog output (0.5 - 4.5 V)
- ❖ Zero: 2.5 V
- ❖ Typical input: 12 V

DODERO



Acquisition system

- ❖ Both **analog** (load cell, accelerometer) and **digital** (laser) data
- ❖ Different voltage levels
- ❖ Signal amplification
- ❖ Sampling frequency
- ❖ Portability of the system

Digital acquisition

❖ HW:

- Portable PC
- Ad hoc signal conditioning part

❖ SW:

- LabView: Programmable configuration:
 - Sampling frequency (e.g. 1 ms)
 - Number/type of input signals
- Matlab/Simulink for data analysis

Hardware - PC

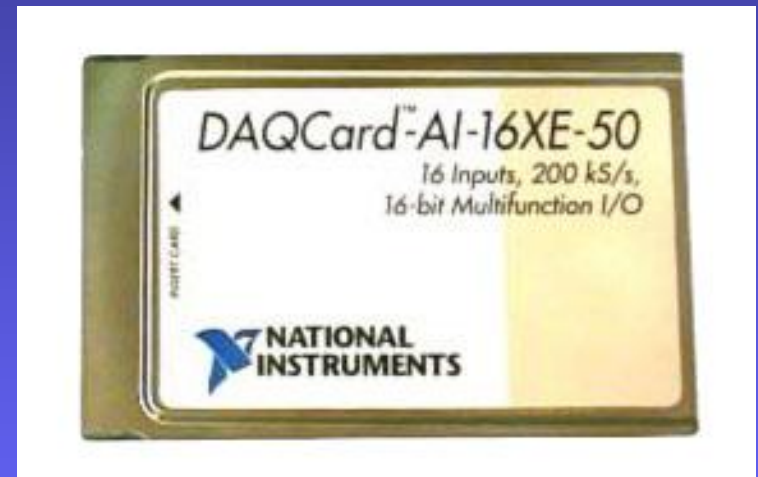
- ❖ Toshiba Satellite 4090
- ❖ Celeron 400 Mhz
- ❖ 64 MB RAM
- ❖ 4 GB HHD



Hardware - Analog Input

❖ DAQCard AI-16XE-50 National Instruments

- 16 single ended/8 differential channels
- 16 bit resolution
- 20 KHz sampling freq.
- 8 digital input channels
- 2 counters

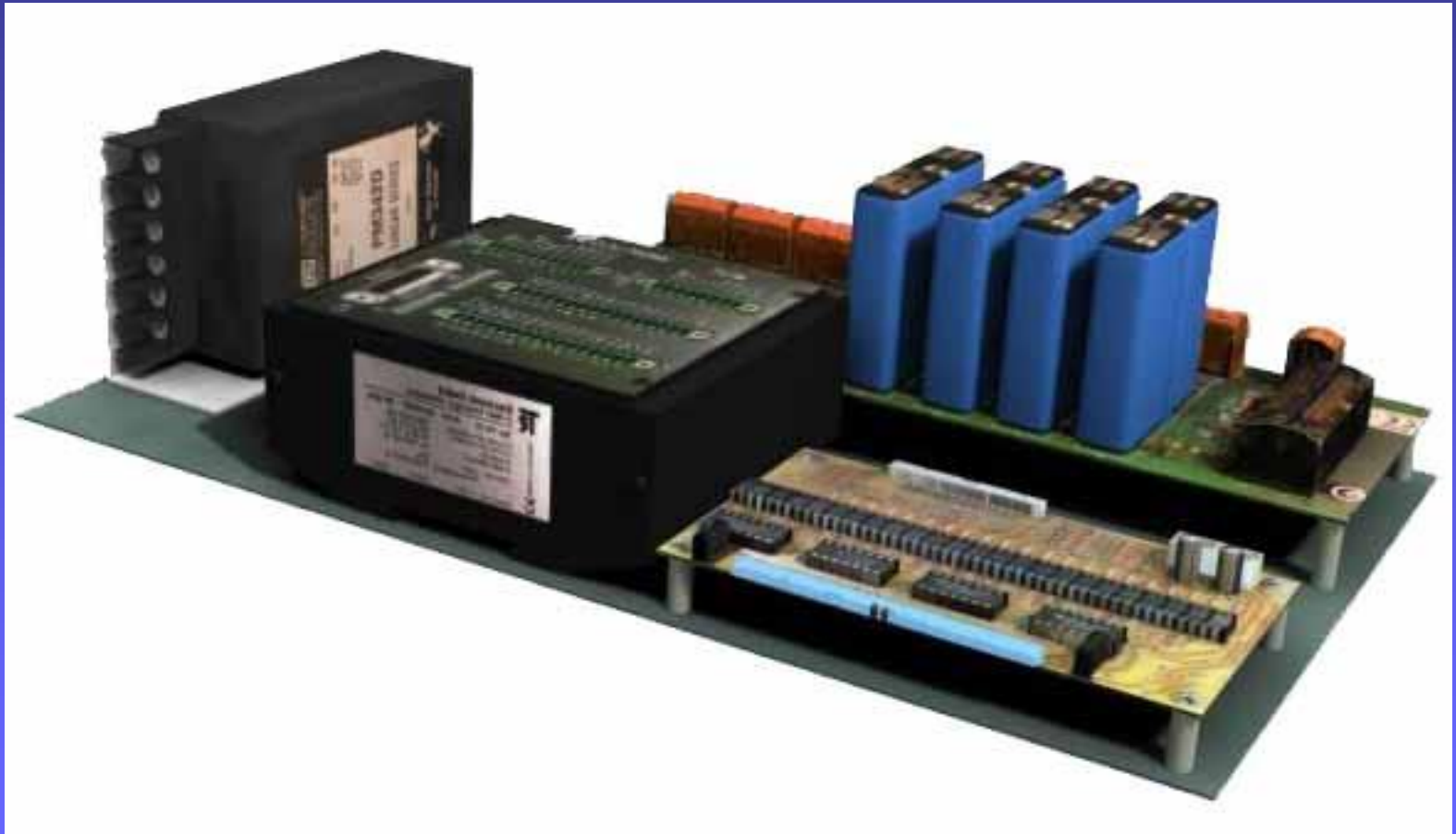


Hardware - Digital Input

- ❖ DAQCard AI-6533
National Instruments
 - 32 digital input channels



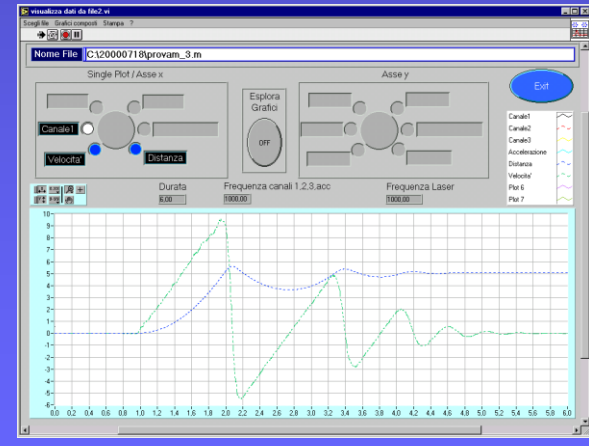
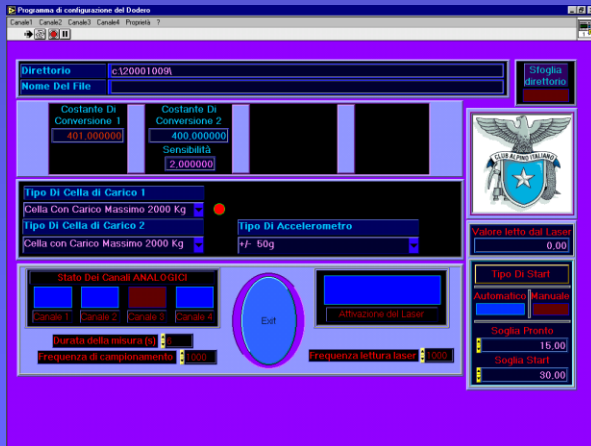
Hardware - Signal conditioning



Software - Data Acquisition

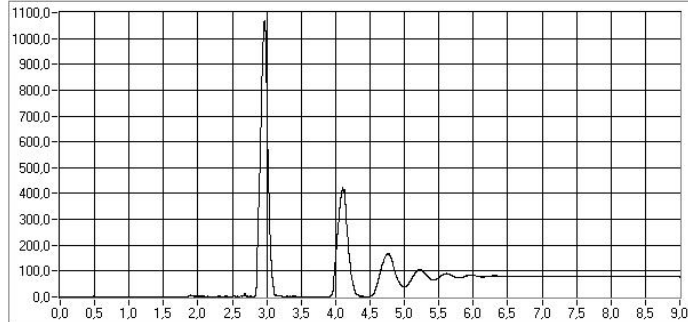
❖ Software based on LabView:

- System configuration (n. of channels, sampling rate, ...)
- Data acquisition
- Data display

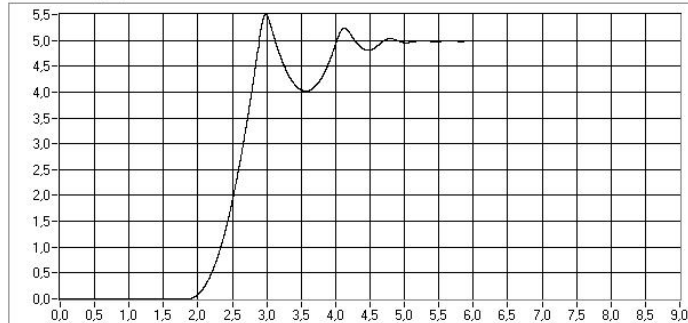


Example

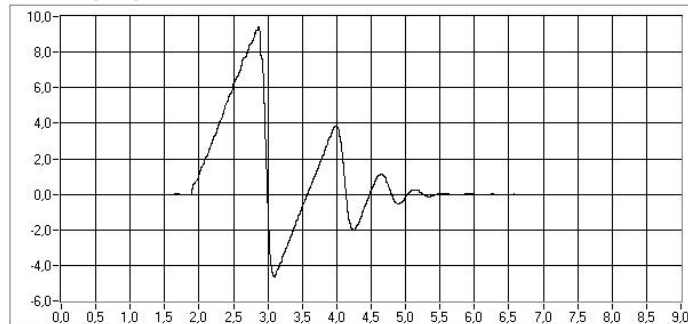
Forza [Kg]



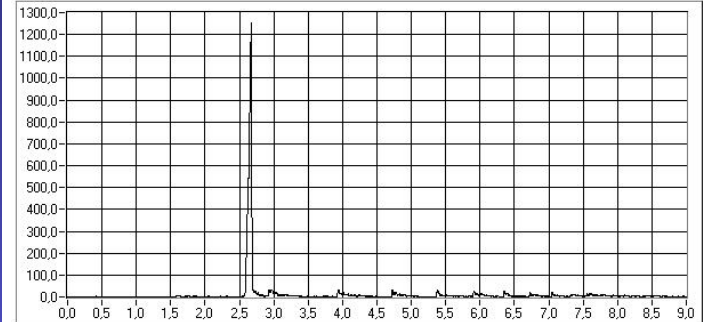
Distanza [m]



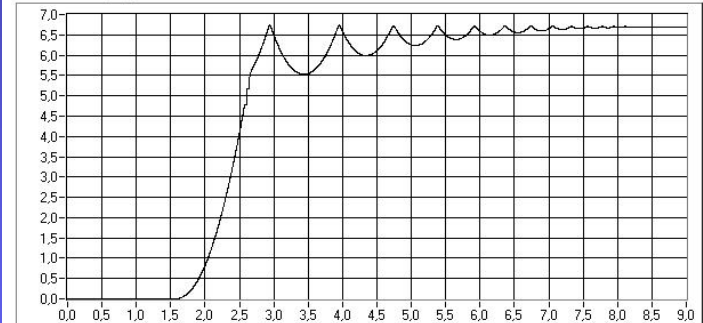
Velocità [m/s]



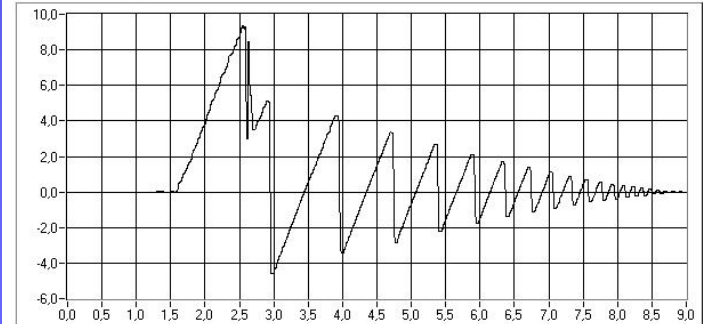
Forza [Kg]



Distanza [m]



Velocità [m/s]



DODERO



Corda

Machine for semi-static tests



Machine for semi-static tests

Characteristics:

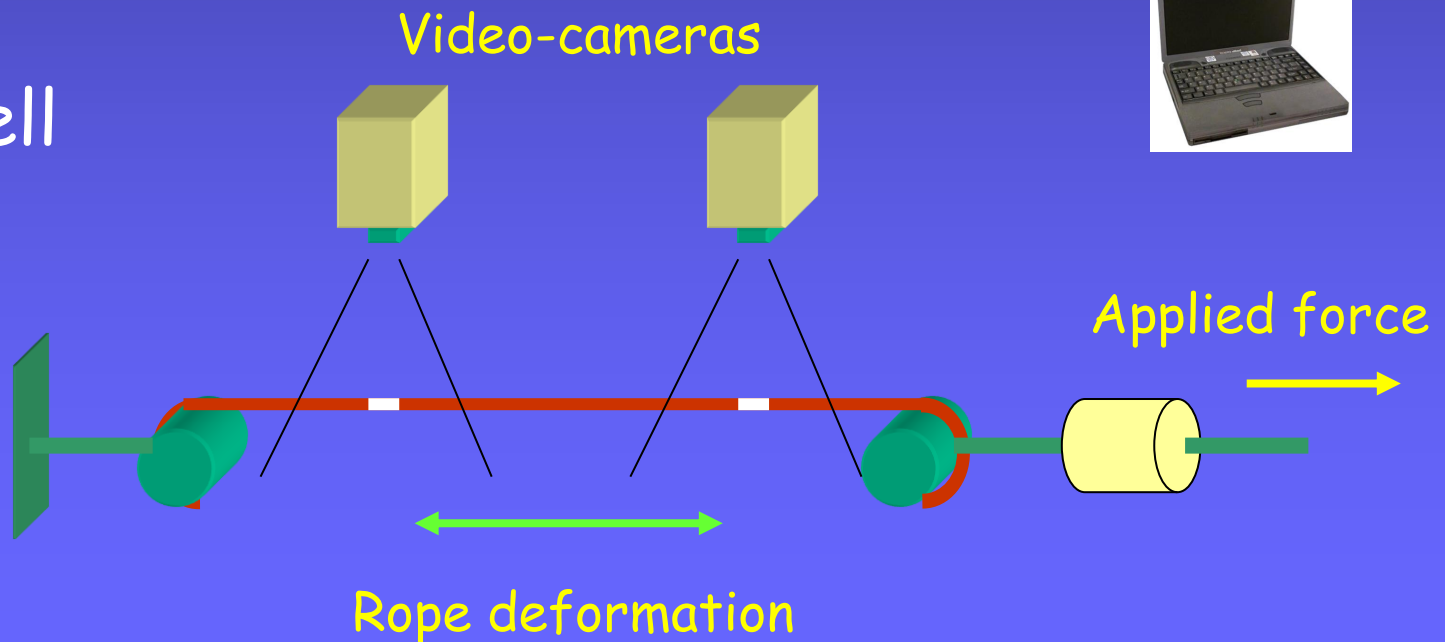
- ❖ Measure of rope deformation
- ❖ Measure of applied force
- ❖ Destructive test

Machine for semi-static tests

Envisaged solution for data acquisition:

- ❖ Pair of digital video-cameras (markers on the rope)

- ❖ Load cell



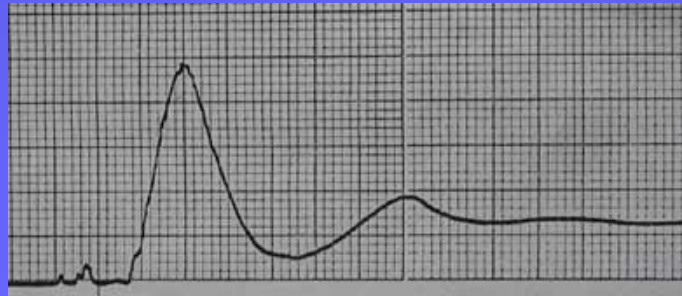
Torre San Lazzaro

- ❖ Structure based on an old electric "tower"
- ❖ Suitable for different test on materials and belaying techniques
- ❖ Used also for teaching purposes (CAI - AG)



Torre San Lazzaro

- ❖ Falling mass
- ❖ Load cells
- ❖ Analog data acquisition



Torre San Lazzaro

- ❖ Experiments on new techniques
- ❖ Teaching activities



Conclusions

- ❖ DODERO:
satisfactory digital acquisition system
- ❖ Machine for "semi-static" test:
under development (2002)