The DYSCO virtual lab for Seismic and Vibration Tests at the ENEA Casaccia R.C.

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ABSTRACT:
ENEA has been recently developing a series of web-based virtual labs, among which the latest was the DYSCO (structural DYnamics, numerical Simulation and vibration COntrol) virtual lab. DYSCO is focused on the seismic and vibration tests and the related numerical simulations conducted at the ENEA Casaccia R.C. Through a web portal DYSCO can give authorized access to remote partners in research projects. Typical partners are public and private bodies in the field of earthquake engineering. During tests, a live videoteleconference give remote users the possibility of visualizing videos and graphs, while exchanging ideas on the upcoming tests via a chat-based session. Also, a professional mixer is used in order to give the remote user a vivid experience of the lab activities. In addition, DYSCO provides a link to archived documentation and the data from past experimental campaigns, along with numerical simulations and other interactive computational options.

Keywords: Web-Based virtual lab, Collaborative Tool, Seismic and Vibration Tests.

1. INTRODUCTION

In the age of ICT, new technologies are becoming more and more available to keep remote engineers, researchers and students in contact for exchanging information on their scientific activities. Consequently, an effort to focus on technical, scientific, and social aspects of fostering scientific collaboration using information technology has been made in the most advanced countries, like the U.S. (National Research Council, 1993). In particular, the World Wide Web can play an important role in educational publishing and in sharing lab activities (Marion et al. 1998, Elgamal et al. 2002).
In the field of earthquake engineering, an example to be mentioned is the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) developed in the U.S. by the National Science Foundation, enabling researchers at remote locations to view or control laboratory experiments in several Equipment Sites from 15 universities all over the U.S. territory (Holmes et al 2002).
Following such innovation concepts, the ENEA Casaccia Research Center has been developing a new network as a collaborative tool for its seismic and vibration test lab. The aim is to introduce in Italy a new approach on the side of communicating and sharing experimental data in order to improve research cooperation and dissemination.
The ENEA Casaccia R.C. seismic and vibration test lab is provided with two 6-degree-of-freedom shaking tables (the largest is 4 m x 4 m), a high resolution 3D motion capture system named 3D-Vision, conventional accelerometers, strain gauges, optic fiber sensors, laser displacement sensors and LVDTs.
The web-based network is intended to allow remote authorized partners in research projects (such as universities, research institutes, public and private bodies etc.) to attend seismic and vibration experiments conducted at ENEA Casaccia R.C. in real time with the possibility of visualizing videos and graphs, while exchanging ideas on the upcoming tests via a chat-based session.
Moreover, a professional mixer equipped with environmental microphones and webcams is used in order to give the remote user an experience as vivid as possible of the lab and the control room.

Also, a purposely designed website provides access to the archived documentation and the data from past experimental campaigns, alongside with a series of interactive options, which make it a real work tool rather than a simply on-line consultation site.

2. DYSCO WEBSITE

The possibility to synchronize visible and infrared cameras allow the remote participation and control of the shaking table tests in a networking configuration of distributed experiments. In the following figure is showed the conceptual structure of this networking configuration within the virtual laboratory DySCo (structural Dynamic, numerical Simulation, qualification tests and vibration Control).
As the experimentation goes on, remote users have the possibility to interact step by step with the experts of the DySCo laboratory, exchanging opinions about the results and, if necessary, agree the modifications in the subsequent steps of the experiment. The connection to DySCo is provided by the ENEA grid of numerical computation, the results are shared in real time via Internet among the partners of the experiment and stored in ENEA web pages for future use and for every remote user who can visualize them by different access privileges.
Together with the Shaking Tables for seismic tests, the figure 4 show the other test facilities networked within DySCo, i.e. the CTM (Combined Temperature-Mechanical) test facility, the electro dynamic shakers for mechanical qualification and the reaction wall for quasi static pseudodynamic test.
One of the goals of this project is also to implement the process of vibration and seismic qualification for nuclear components and system: the remote control allows the customer to immediately analyze the results together with the ENEA scientists and visualize where the problem for a non-qualification notify is.
The DySCo Virtual laboratory comes from many research projects of seismic protection for civil structures like as: TREMA, RELUIS and TELLUS STABILITA.
The measure of the displacements is a crucial task for the numerical and experimental studies in structural dynamics, especially within the displacement based approach in seismic design and calculations. The ENEA grid and the CRESCO (Computational RESearch center on COmplex system) parallel computational system, give to the remote user the opportunity to run the heavy finite element structural analysis codes by the most important commercial software available by CRESCO.

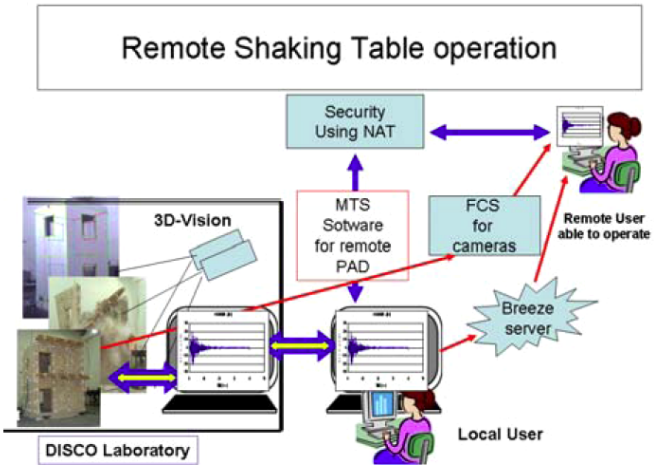


Figure 1. The possibility to synchronize visible and infrared cameras allows the remote participation to the shaking table tests in a networking configuration of distributed experiments

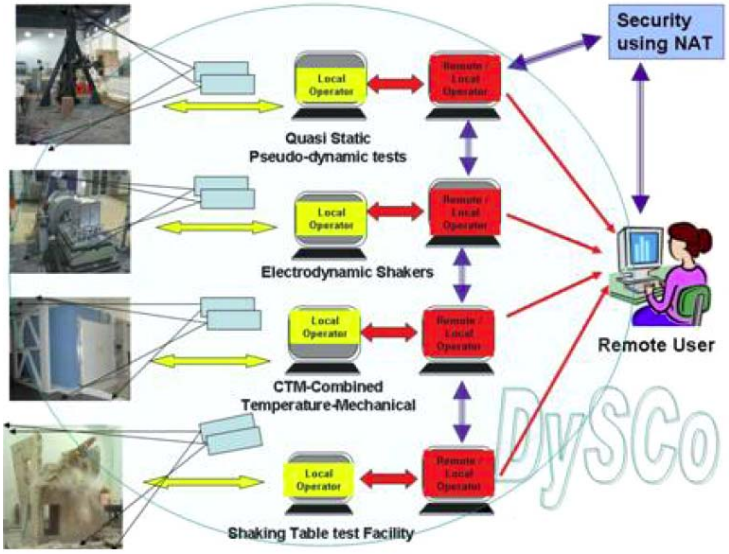


Figure 2. The possibility to synchronize visible and infrared cameras allows the remote participation and control of the shaking table tests in a networking configuration of distributed experiments with other laboratories.

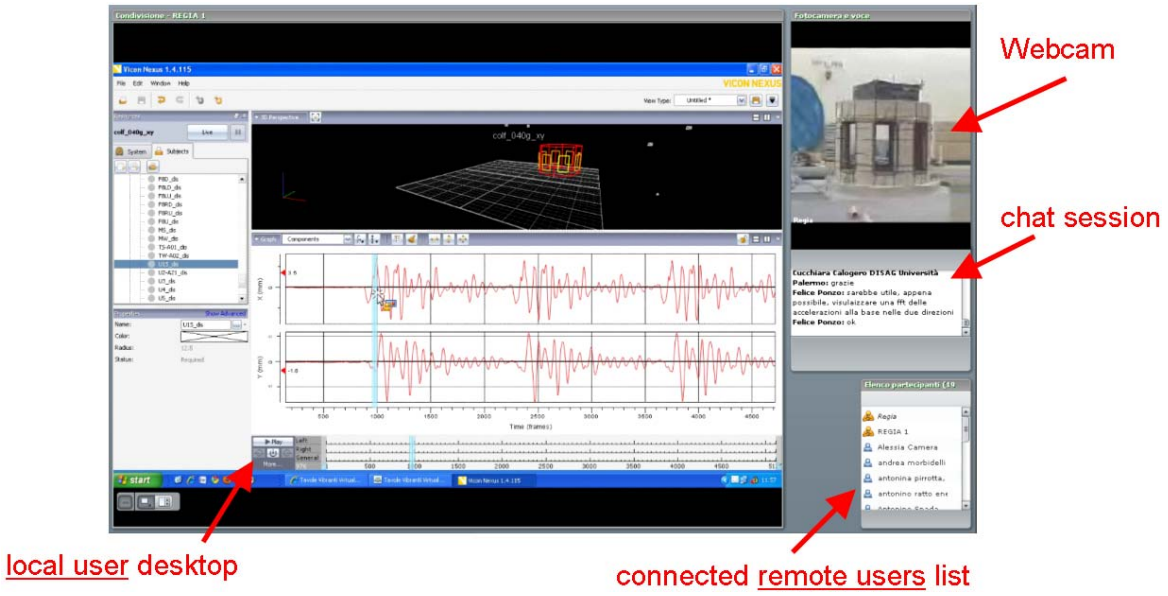


Figure 3. The possibility to synchronize visible and infrared cameras allows the remote participation and control of the shaking table tests in a networking configuration of distributed experiments with other laboratories.

3. WEB PORTAL

In the age of ICT, new technologies are becoming more and more available to keep remote engineers,

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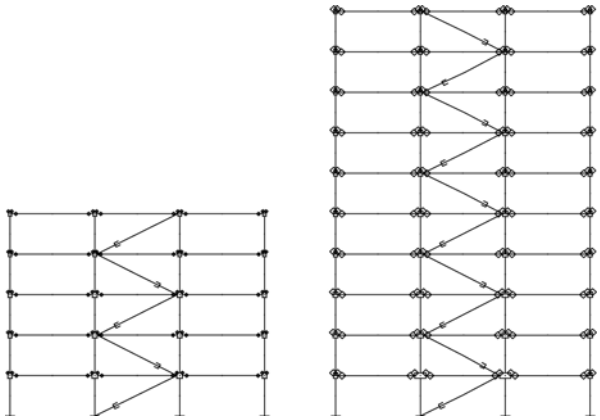
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Figure 1. Mathematical models for non-linear response history analysis

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$$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k} \qquad (5.1)$$

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