

# Experimenting through the Web a Linear Variable Differential Transformer

Ricardo J. Costa and Gustavo R. Alves

LABORIS / Polytechnic Institute of Porto - School of Engineering (ISEP), Portugal

**Abstract**—Aiming for teaching/learning support in sciences and engineering areas, the Remote Experimentation concept (an E-learning subset) has grown in last years with the development of several infrastructures that enable doing practical experiments from anywhere and anytime, using a simple PC connected to the Internet. Nevertheless, given its valuable contribution to the teaching/learning process, the development of more infrastructures should continue, in order to make available more solutions able to improve courseware contents and motivate students for learning. The work presented in this paper contributes for that purpose, in the specific area of industrial automation. After a brief introduction to the Remote Experimentation concept, we describe a remote accessible lab infrastructure that enables users to conduct real experiments with an important and widely used transducer in industrial automation, named Linear Variable Differential Transformer.

**Index Terms**—Remote Experimentation, Distance Learning, Remote Lab, LVDT.

## I. INTRODUCTION

The increasing demand for culture and knowledge, imposed by the society, alerted the educational community for the need to design creative ways to motivate and facilitate people for the learning/teaching process. Personal Computers (PCs) and the Internet have been playing an important role in this topic, by promoting the deliver of pedagogical contents, like documents, demonstrations, images and others, to all, independently of their social conditions or geographical restrictions. However, in recent years, these static contents are being complemented with dynamic ones, provided by E-learning environments (Virtual Learning Environments, VLE), which include components that allow students and teachers to interact in the same way as they do in a teaching room. These environments provide multimedia contents, administrative, learning, and assessment management tools, supported by communication platforms that allow interaction among users (e.g. chat rooms, forums, etc.)<sup>1</sup> [1].

Spite the fact E-learning is already a reality in our society, the pedagogical contents are being continuously expanded in engineering and sciences areas, where requirements suggest to follow the common rule that it is better to ‘learn by doing’. Some experts argue simulations could fulfill this requirement. However, these can hardly contemplate unpredictable situations encountered when

there is an interaction with real experiments. Besides, there are many specific and complex tasks impossible or very difficult to replicate with software simulation tools where, in such cases, it is less expensive to place the all experiment online (through the Web) in opposition to develop a simulation model, from the scratch. Therefore, in situations where simulations can not fulfill the specific requirements of a real experiment, or when cost figures suggest providing access to real equipment rather than simulating it, the ‘learn by doing’ rule should be satisfied by the Remote Experimentation (RE) concept, as suggested by several past and ongoing projects (e.g. PEARL [2], MARVEL [3], RExNet [4], PROLEARN [5]). Notice however that simulations still play a fundamental role in situations where the cost of implementing a remote experiment is high or when replication is needed. Another aspect is when the experiment includes the use of critical equipment that can be damaged by an erroneous use. In such scenarios, simulating the experiment in a first phase allows the user to acquire the necessary skills that will then allow him/her to control the remote equipment in a safer way. Other scenarios include the combined use of real equipment with simulation models, in a technique named as mixed-reality [6].

RE aims to supply real experiments able to be accessed and controlled from anywhere, by anyone, and at anytime, using a simple PC connected to the Internet [7]. In a general perspective, several aspects have been studied to identify the benefits of RE to education & training, as illustrated by figure 1.

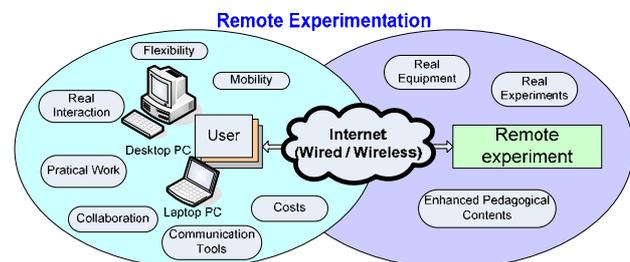


Figure 1. Remote Experimentation scenario

In an educational perspective, RE is considered to be a complement and not a substitute of a lab session since not all tasks can be done remotely (e.g. it is not feasible to remotely mount an electronic circuit, which impairs students from acquiring the required ability to handle electronic components and assembling them) [8]. Moreover, mobility and flexibility provided to students and teachers in their tasks are improved, since a remote

<sup>1</sup> Moodle is an example of a freeware VLE, available at <http://moodle.org/>.