



A SYSTEMATIC TWO-LAYER APPROACH TO DEVELOP WEB-BASED EXPERIMENTATION ENVIRONMENTS FOR CONTROL ENGINEERING EDUCATION

**H. VARGAS, J. SÁNCHEZ, N. DURO, R. DORMIDO,
S. DORMIDO-CANTO, G. FARIAS, S. DORMIDO**

*Dept. of Computer Science and Automatic Control
UNED, C/. Juan del Rosal 16
28040 Madrid, Spain*

F. ESQUEMBRE

*University of Murcia
Campus Universitario de Espinardo
30100 Murcia, Spain*

CH. SALZMANN, D. GILLET

*Laboratoire d'Automatique
EPFL, CH-1015
Lausanne, Switzerland*

ABSTRACT—This paper introduces the systematic approach currently used by the Department of Computer Science and Automatic Control of the Spanish University of Distance Learning (UNED) to develop Web-based laboratories for distance learning of topics with high technical contents such as control engineering. This approach differentiates two layers in the construction of web-based laboratories: the *experimentation layer* and the *e-learning layer*. For the experimentation layer, LabVIEW and data acquisition boards from National Instruments are used to create the server-side applications and *Easy Java Simulations* for the client-side interfaces. For the e-learning layer, the *eMersion* environment is used to support the required flexible educational scheme. This paper describes the programming techniques implemented and the design considerations that justify these particular choices. As an illustrative case-study, an example of development of a web-based application is discussed, in which an electrical drive servo-motor is introduced as a convenient setup to practice with motion control applications. Other significant examples of web-based experiments developed by the authors are also reported.

Key Words: Remote laboratory, distance learning, control engineering education, interactive systems, web-based experimentation, collaborative learning.