COBBALT "MULTIMEDIA SELF-LEARNING TELECOMMUNICATIONS ON INTERNET"

Safwan El Assad, Jacqueline Boniffay, Sebastian Pavel, Evangelos Pallis

ABSTRACT
E-learning represents in our times a very important technology for learning/teaching without having many of the constraints of the classical methods. COBBALT is a multimedia Web based application for self-learning telecommunications. This application concerns *students* that are interested in the field of telecommunications, at an intermediate level, and offers as principal services the access to the course and to additional resources, the possibility of self-testing one's knowledge, a section providing some interactive experiment's simulations and a help section.

KEYWORDS
e-learning, multimedia, telecommunication, Web, Internet , HTML, XML

INTRODUCTION

Recent advances in telecommunication and multimedia-construction technologies have enabled World Wide Web to become the dominating networking platform that can host, deliver and distribute a variety of multimedia service applications, commonly known as *electronic applications (e-applications)*, which enable users/citizens to easily create, manipulate, access and deliver their own information any-time from any-where. Such an application is the *e-learning* one that enables citizens/students/potential learners to adopt and to apply knowledge, to think independently, to collaborate with others and to actively participate in the education process from his/her own premises, by breaking the classical boundaries of time and space.

This paper presents COBBALT, a Web based e-learning application, which is the implementation of a particular teaching methodology in the field of telecommunications. COBBALT enables any potential learner to acquire information or test his/her knowledge skills in the field of telecommunications, at intermediate level, via common Internet connections, by providing telecommunication courses in a very intuitive manner, besides utilising user-friendly tools and interfaces
After this introductory section, the rest of this paper is organised as follows: Section 2 presents an overview of the application's structure, while Section 3 outlines the teaching methodology and the conceptual ideas adopted prior to the implementation of COBBALT. Section 4 presents the principal technologies used and reports on detailed implementation issues of Cobbalt. Finally, Section 5 concludes the paper.

STRUCTURE OF APPLICATION

COBBALT utilises a user friendly Web based interface that comprises i) three modules, each one divided into four sections (Content, Resume, Exercises, Lab Work), ii) a Help section, iii) a Search engine, and iv) a Glossary section. (See Figure 1.)
Specifically, the Help section provides general information about this application and help about the employment of the product. The Search engine allows a *student* to instantly acquire information about

specific words or whole phrases contained in the whole COBBALT content (course) The search results are presented to the student/user in a listed form of text sections where the word or phrase is contained. The Glossary section provides the capability of finding, very quickly, the definition of any term (notion) presented in the content of the course.

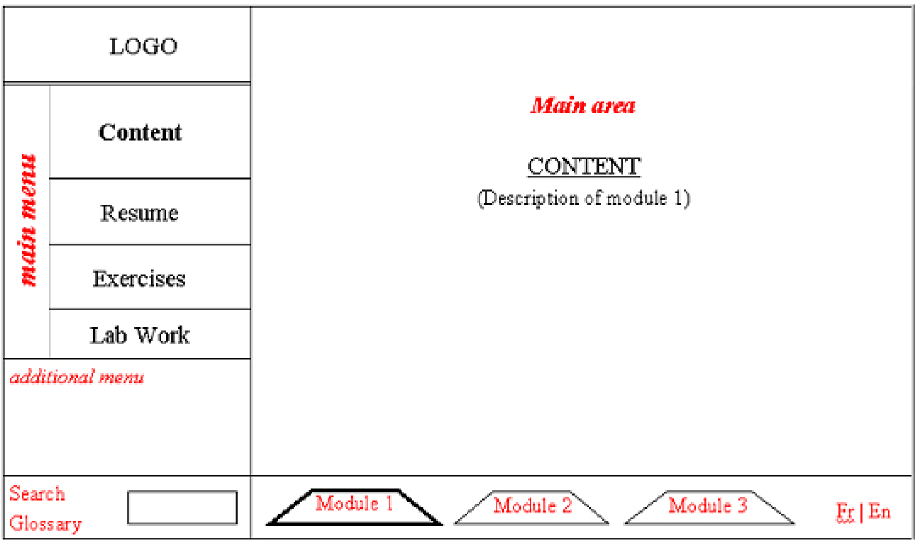


Figure 1. The conceptual view of the application's structure.

Furthermore, the application provides options for the preferred language (e.g. English and French) in which the course will be available at the student, who also can switch between them at any time.
By choosing any of the three modules, one can access the four main sections available:

- The *Content*

  Comprises the information that composes the course. This information is presented in a very intuitive manner, besides providing the user with ease navigation functions among its different parts.
- The *Resume*

  Includes a condensed and resumed version of the content.
- The *Exercises*

  Choosing this section, a self-test procedure is available to the student, concerning his learning assimilating capabilities in respect to the information he/she acquired during after going through the *Content* and/or the *Resume* sections.
- The *LabWork*

  This section offers a virtual laboratory environment, where the student is able performing relevant experiments in a visual and interactive way.

CONCEPTION AND METHODOLOGY

The teaching methodology that was adopted can be resumed as follows: Provide somebody (namely as *student throughout the paper)* the opportunity to access the information he/she needs, let the student to acquire it and help him/her to assimilate this information by providing interactive capabilities. Then, give the student the possibility to test himself and to experience some interactive experiments. Provide every possible tool he may need, so that to use only a computer and the COBBALT application.
The Content, Resume, Exercises and Lab Work sections provided in the COBBALT application making use of this methodology. The following paragraphs provide an in depth description of these sections.

CONTENT SECTION

This section is designed in such way so that to present the subject of the telecommunications course in a user-friendly environment

The information provided by the course consists of properly integrated text, formulas, graphics and images. Since the telecommunications course covers large thematic areas the information provided to the student is divided into chapters that follow a logical structure and subjects of the course. Each chapter treats a certain principal topic of the material and is logically connected to the previous and the next chapter.

In addition, each chapter comprises one or more specific points, such as introduction, significant theorems, laws, definitions, relations etc. Therefore, it was considered as useful to divide the chapters into sub-chapters, each one representing such a specific point from the principal part.

Thus, the *partition* of the content is a division of it into levels that constitute a tree structure. This structure is logical and comprehensive, as it follows a deduction approach – from general issues and topics to the more specific ones. Still, in the subchapters, there can be topics that could be differentiated into another level but from a user-friendly point of view, the structure of the content has only those two levels – chapters and subchapters. Therefore, it is not sliced into smaller pieces since it can become difficult to follow the threads. Any differentiated topic in a subchapter remains as a part of that subchapter and not as a sub-subchapter

Below is a general idea of how the content will be presented to the user, it has been intentionally done to be very intuitive and user-friendly. There are six areas (frames) present in all screens(refer to Figure 1.):

- *Logo*
  in the upper-right corner of the screen, where the logo of the product is visible. By clicking it, the user can go to the main screen of the product intro.
- *Main menu*
  left side of the screen. A menu giving access to the different main parts of the course – content, resume, exercises, laboratory work. By clicking each of its items, the corresponding part appears in the main area of the screen. Although this menu looks the same, it is context sensitive, i.e. it displays the parts corresponding to the chosen module (see Modules).
- *Additional menu* (submenu)
  below the main menu, optional. If present, the menu items depend on the part chosen in the main menu. If the Content part is selected, it will display the chapters and subchapters for module x. If Exercise part is selected it will display the problems and demands.
- *Search and glossary*
  in the lower-left corner of the screen. The user can type a specific word or a phrase in the search area and after clicking Search any results found will be displayed in the main area; The Glossary has been provided to assist the user in finding specific terms (notions) that he encounters reading the content.
- *Modules*
  lower part of the screen. Place to choose which is the current module to be displayed with its content, resume, Exercises and laboratory work.
- *Language*
  the course is intended to be available in different languages. Here the user can choose the appropriate language. All texts items will change accordingly (button labels, captions, links etc.) and of course all the content of the course.
- *Main area*
  any choice (selected menu item, chapter, search, language etc.) the user makes from the six frames results in this area.

RESUME SECTION

The resume section provides the same information as presented in the content section but in a much more compressed form and, if possible, with some extra notes that are not available in the original course. The purpose of this section is to allow an easy access to the information of anyone who has some knowledge in the field of telecommunication. From this point, the user can reach in any moment the information widely presented in the content section.

For each of the three modules, there is a text that presents the same information, from the corresponding content section, is provided, but the way of its presentation is different. We can see this text as the resume of the one in the course (content section).

The text contents keywords and/or key phrases. These keywords represent a concept or a notion from the telecommunication's field (egg: code, coding, etc.). By clicking on any of these key words, the user has access to the definition of the corresponding notion, to the list of all the places where there is a reference to it in the content section, to links to web resources or to the glossary.

The *notions* are definitions that appear in the telecommunication field. Informatically speaking, these *notions* have a unique id, a content and a list of other *notions* that are related to the present one. In fact there can be identified an oriented graph of *notions* (in reference to Figure 2. the conclusion drawn is that the *notion* coding is defined using other *notions* as: code, entropy, channel.).

The *objects* are parts of the course (from the content section) that have an id unique, a list of *notions* that are explained in that part and the path where the portion is present in the course (Egg. Chapter1, Supchapter1,…).

The *professor defines the notions and the objects*. He has the obligation to introduce all the *notions* he considers to have relevance. It is he, who can identify in his own course the *objects* that can encapsulate one or many *notions*.

The user reads the *resume*, clicks on a key-word and chooses to see all the *objects* that contain the selected *notion* (represented by the key-word or key-phrase). The definition of the *notion* is displayed, then a list with all the *objects* in which the *notion* is explained. For each *object*, there are one or many *notions*. The user can choose to see the definition and the related *objects* for each of any other *notion*.
In this way, the user can navigate through all the *notion*'s graph and can reach the explanations for any of the *notions*.

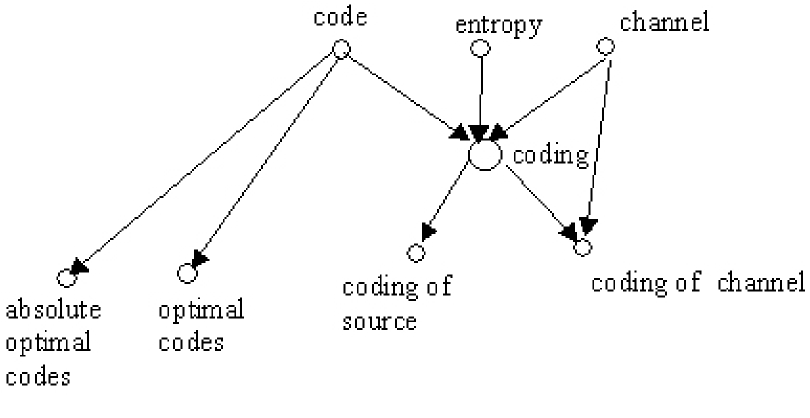


Figure 2. Example of the *notion*'s graph

EXERCISE SECTION

This section provides the *student* with the possibility of testing himself about the knowledge acquired. In the teaching process, this section reasonably follows the theoretical content and/or resume sections. After having completed the corresponding part of the content of the course (egg. the relevant chapter), one must be able to solve the exercises proposed in this section. The *student* has full access to all the *problems* and *demands* and he can pass to any of them at any time.

- A *problem* is a general topic in an exercise; it contains the description of the exercise and several demands.
- A *demand* is an instance, the very task to be completed by the *student*. Each of the demands regards writing an *equation* (formula). No matter which problem topic and demand he chooses, he is supposed to *construct* the requested formula using the means provided by that application.

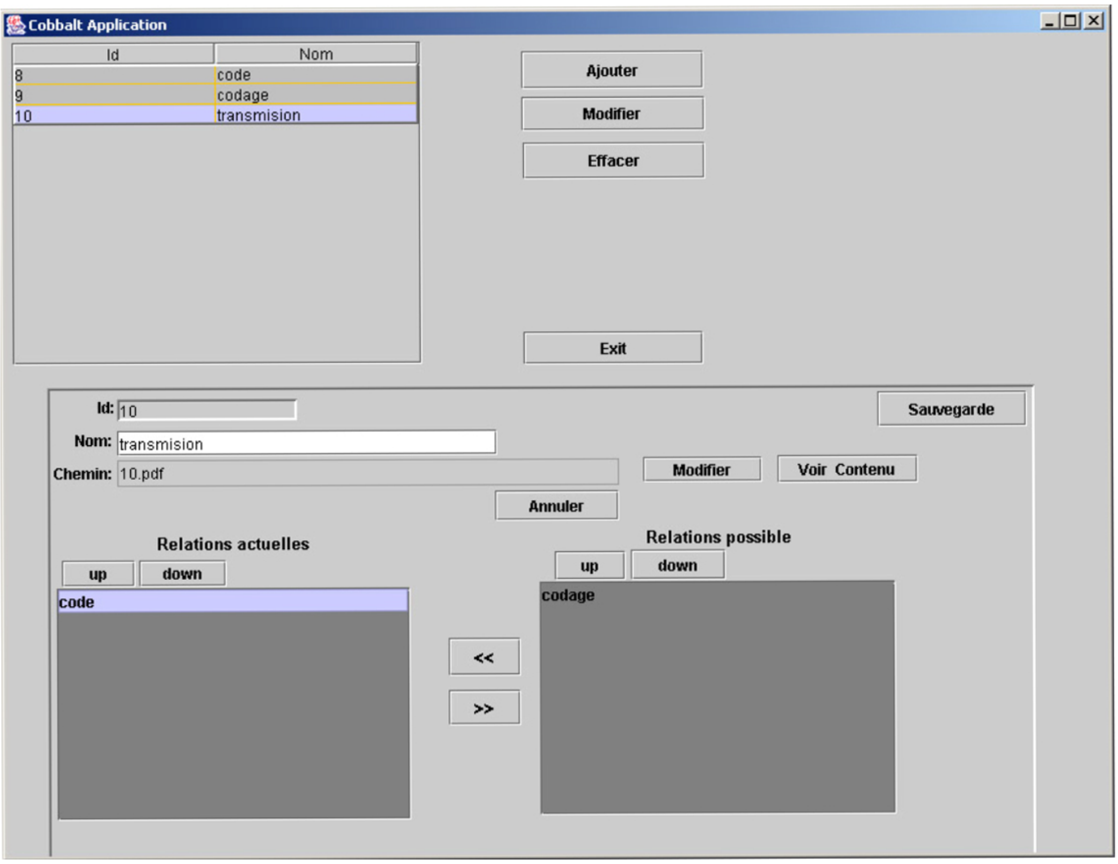
Of course, after completing each task the *student* must be able to know whether his answer was correct. At any moment he wishes, whether he had completed all of it or not, he is allowed to do this by clicking a button and the answer will be verified. A good aspect about this is to allow the *student* to make one or two tries before his solution is considered final. Consequently, it is useful and meaningful to have another feature, which is to give the user some hints and tips regarding the problem after an unsuccessful try. In this way he will be given some directions to the matter in question. He will be suggested which part and specific *notio*ns of the course concerning the problem to revise.
This section together with the resume and the labwork are the most interactive ones. Technically speaking, the data the user sees on the screen is dynamically generated in relation with his previous actions.

LAB WORK

By this section, the application provides an area of simulations.
As in a real school, the *student* must have the possibility of doing some practical experiments. The knowledge acquired through the previous sections and the tools provided by the application should help a *student* to accomplish the task of executing the required practical experiments.

IMPLEMENTATION

As an Internet application, Cobbalt employs the use of various technologies currently available.
However, the final look of the application gives the impression of a unified, integrated tool.
The *Content section* is implemented mainly using the classical HTML and it follows closely the conceptual model presented in the Figure 1. In addition, JavaScript and Java Applet help to give to this section a “dynamic face”.
While all the pages are written using HTML, the de-facto mark-up language used all over the Internet, the scripts java are employed in order to create an easy mechanism of navigation throughout the hundreds of pages of text representing the telecommunication course. As an example, the menu at left displaying links to the different sections can expand itself in order to display all the chapters and subchapters corresponding to the current module. This is done by specifying some values in the parameters of the applet used to handle with the menu.
For the *Resume section,* the Java and XML technologies are largely used. While XML helps better structuring the data on the server, the Java language and some additional java technologies like *java sockets, jdbc, swing, servlet, jsp* are used to support all the functionalities provided in this section.



Id	Nom
8	code
9	codage
10	transmision

Id: 10
Nom: transmision
Chemin: 10.pdf

Relations actuelles
code

Relations possible
codage

Figure 3. Screenshot of the administration module

The application software is composed by two distinct functional modules:

- The administration module
  helps the professor to manage the dynamical structures of *notions* and *objects*.
- The module used by the *student*
  provides the *student* with all the functionality necessary to navigate ,in a very interactive manner, through the hierarchy of *notions* and *objects*.

The administration module is employed from the professor to structure his dynamic components of the course. While the course represents the statically component, the *notions* and the *objects* are the dynamical ones. The professor is provided with this administration module and using it, he can add, delete or modify the existing *notions* and *objects* using his computer over the Internet. All the modifications are stored by this module on the server's application.

The module actually used by a *student* merely uses the statistical data on the server (databases and statistical folders) and displays the requested information. This kind of structuring assures the further improvement of the relations among the different entities (*notions*, *objects*, etc.), which are immediately reflected on what the *student* sees on the screen. Figure 3. presents a screenshot for the administration module used by the professor.

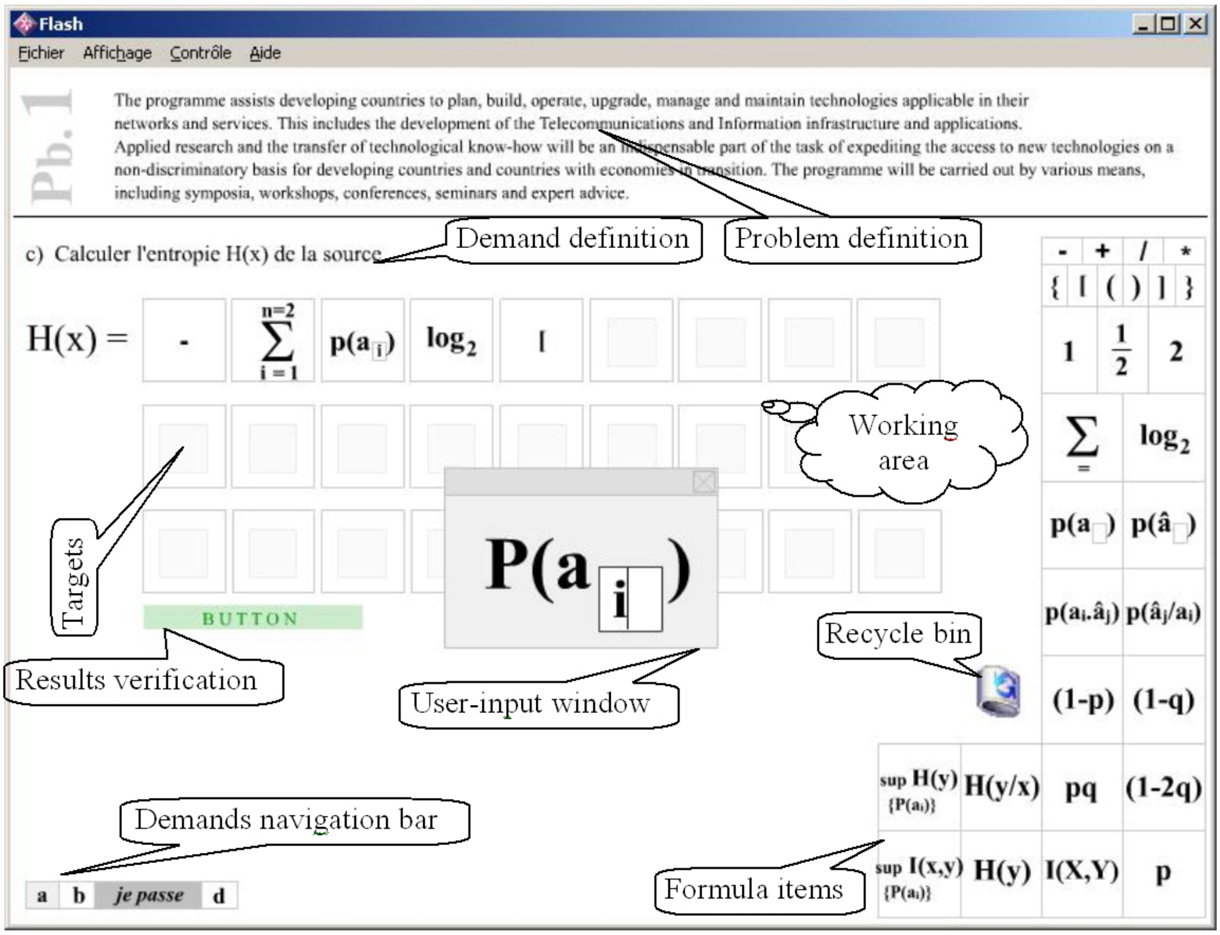
The type of problems in the *Exercises section* is defined in such a way that the *student* has to construct a formula (equation) as response to some demand. Because it is not possible to enter this equation directly from the keyboard (much to many symbols and elements which cannot be inserted and manipulated directly - sums, indexes, Greek letters, …), the solution chosen is to provide the *student* with the possibility of using some kind of editor in order to compose his equation.
The editor proposed with the Cobbalt application has as main features:

1. *Reusability*
   each symbol is available for multiple use on the working area.
2. *Deletion and positioning*
   once placed on the working area, each symbol can be deleted or replaced at any time.
3. *Completion*
   common symbols such sums are available for editing, i.e. different indexing which is dependent on the user input.

The technology used to implement such an editor is *Macromedia Flash* as it best fits the needs of the application. Its multimedia and application development features allow the creation of rich user interfaces, applications, e-learning courses etc. It is a fast and powerful way of combining programming, animation, and design.
Technically speaking, the idea is to create one first exercise using Flash. This exercise can be seen as a template. Because all the exercises have the same structure, the simple modification of some external parameters of the Flash program will determine the creation of a new exercise.

The general structure of the layout for an exercise is presented in Figure 4.
All the principal elements are presented in the list below:

- *Problem definition*
  text describing the problem to solved. This text is common for all demands included in that problem.
- *Demand definition*
  text describing the current demand being solved .
- *Targets*
  set of squares, targets available for items to be placed.
- *Formula items*
  panel containing mouse movable formula items. These items are defined for each different problem.
- *Results verification*
  a button which invokes results verification, comparison with the user input and the correct answer.
- *Demands Navigation bar*
  buttons to pass to the different demands of the current problem.
- *Recycle bin*
  for deleting formula items; drag and drop over the recycle bin any item which is no needed on the target area.
- *Working area*
  the stage where you have the items are placed and manipulated.



The programme assists developing countries to plan, build, operate, upgrade, manage and maintain technologies applicable in their networks and services. This includes the development of the Telecommunications and Information infrastructure and applications. Applied research and the transfer of technological know-how will be an indispensable part of the task of expediting the access to new technologies on a non-discriminatory basis for developing countries and countries with economies in transition. The programme will be carried out by various means, including symposia, workshops, conferences, seminars and expert advice.

c) Calculer l'entropie H(x) de la source

Figure 4. Screenshot of the Flash module

The simulation modules in the *Lab Work section* are provided by some additional specialized applications such as: Matlab, Simulink, DSP, etc. All these modules are completely integrated in Cobbalt application.

CONCLUSION

In this paper we showed the way in which the Cobbalt project has applied the principles of e-learning, mainly the paradigm of Computer Mediated Teaching, in the construction of a student-centered interactive web application. The extensive need of new and expensive lab material - due to the rapid evolution of technology and the growing number of students – is a current problem of most of telecommunication schools. The simulation environment offered by Cobbalt - visual representations of abstract concepts and practical lab experiments – completes or offers an alternative solution for the classical lab study. The self-study characteristic of Cobbalt is very compatible with its use in a more classical pedagogic situation supervised by a teacher.

REFERENCES

PEARL Project: http://kmi.open.ac.uk/projects/pearl

http://wrmw.cio.com/research/elearning

Sebastian PAVEL, Sophia OULINSKA, “Projet Université Virtuelle des Pays de la Loire : Cobbalt” Rapport interne (2001-2002), 60 pages.

Associate Prof. Safwan El Assad
Ecole polytechnique de l'université de Nantes
Rue Christian Pauc BP 50609
44306 Nantes Cedex 3 – France
Email: safwan.elassad@polytech.univ-nantes.fr

Associate Prof. Jacqueline Boniffay
Ecole polytechnique de l'université de Nantes
Rue Christian Pauc BP 50609
44306 Nantes Cedex 3 – France
Email : jacqueline.boniffay@polytech.univ-nantes.fr

Dr Evangelos Pallis
Center for Technological Research of Crete
Stavromenos 71500, Heraklion, Crète, Grèce
Email: pallis@iit.demokritos.gr

PhD Student Sebastian Pavel
Ecole polytechnique de l'université de Nantes
Rue Christian Pauc BP 50609
44306 Nantes Cedex 3 – France
Email: sebastian.pavel@polytech.univ-nantes.fr