

RoboticWEBook: an electronic book initiative

Maria Isabel Ribeiro, Jorge Dias, John Hallam

- (1) Institute for Systems and Robotics, Instituto Superior Técnico, Av. Rovisco Pais 1, 1049-001 Lisboa (PORTUGAL)
- (2) Institute for Systems and Robotics, Electrical Engineering Department, University of Coimbra, Pólo II, Universidade de Coimbra, 3030 Coimbra (PORTUGAL)
- (3) Artificial Intelligence, Division for Informatics, University of Edinburgh, 80 South Bridge, Edinburgh EH1 1HN (UK)

E-mail: mir@isr.ist.utl.pt, jorge@isr.uc.pt, john@dai.ed.ac.uk

***Abstract.** Robotics is a relatively new research area, where maturity has not yet reached the point where a variety of textbooks is available to support undergraduate and graduate courses. Furthermore, the spread of subjects involved in a robotic system renders difficult the choice of topics to be covered in such courses. The actual Web technologies are a good support to accommodate an incremental electronic initiative, with diverse contributions, and whose contents may assist students and teachers working in the area of robotics. This paper presents the proposal of the RoboticWEBook, an electronic book initiative whose development is under discussion within EURON.*

1. INTRODUCTION

Robotics is a relatively new research area, where maturity has not yet reached the point where a variety of textbooks is available to support undergraduate and graduate courses. The spread of areas related with robotic methodologies renders difficult the choice of topics to be covered in a particular course and the selection of a textbook to be adopted. This often pushes academic staff to write their own notes and tutorials in a time-consuming and sometimes unrewarding activity. The robotics researchers, students and teachers, tackling different scientific topics could benefit from a joint effort of making this material available in an organized, centralized and up-to-date way. This effort, leading to an evolving compendium, will greatly help their activities.

The actual Web technologies are a good support to accommodate an incremental electronic initiative, with diverse contributions, and whose contents may assist students and teachers working in the area of robotics. This paper presents the proposal of the RoboticWEBook, an electronic book initiative whose first steps are under way within EURON-European Research Network.

The concept of a web compendium has already been implemented in the area of computer vision. The

CVonline: the Evolving, Distributed, Non-Proprietary, On-Line Compendium, [1], developed at the University of Edinburgh, serves the CV community both at teaching and research levels. Besides the evident benefit for this and related research communities, CVonline has the interesting characteristic of having a permanently open contribution policy. Contributions may cover different aspects, namely new tutorials, improved tutorials, suggestions for new topics under a given category, comparisons of several approaches in a topic, examples of use and implementations.

A quick search on the web provides information on electronic books available in different areas, namely, chemistry, [2], ceramics, [3], African languages, [4], to name but a few. These sites share the same purpose of providing on-line and incremental databases of a particular area, eventhough the site design, the user interaction and the call for contributions may configure different solutions.

The Math Archives, [5], shares some of the goals of the previously referred web sites, namely in providing materials which are used in the teaching of mathematics. However, it also provides a collection of educational software. Other covered areas are laboratory notebooks and problem sets of lecture notes and reports on innovative methods. A second strength of the Archives is its extensive collection of links to other sites that are

of interest to mathematicians. Resources available through these links include electronic journals, preprint services, grant information, and publishers of mathematical software, texts, and journals.

In the area of mobile robotics, [6] has the same purpose of being a repository of robotic techniques, sensor description and applications. However, except for its periodic revisions, it is not an evolving source of information, and although serving the entire community and describing its most relevant R&D work, but the text has been written by three authors.

This RoboticWEBook proposal aims at providing an up-to-date source of tutorial material in the area of robotic methodologies with emphasis in mobile robotics. Its development is under discussion within EURON and the views and opinions in this paper are those of its authors. The final proposal will be submitted to discussion prior to the final implementation within EURON.

2. RoboticWEBook OBJECTIVES

The electronic book on Robotics is an initiative under the frame of the European Research Network – EURON. Its main objectives are:

- To provide a collection of hypertext tutorials on key topics on robotics, with emphasis in mobile robotics,
- To provide a complete description of methods and applications of robotics methodologies covering the main topics on practice and research,
- To show results in real experiments that apply such methods,
- To provide easy links to related material (papers, thesis, reports, virtual labs, emblematic research projects).
- To provide public domain and shareware software for robotic applications.

The book targets undergraduate and post-graduate students, teachers responsible for courses in the covered areas and researchers with activities in the field. The RoboticWEBook is intended to be the place where high quality tutorial work will be found and where a set of pedagogical piece of materials is posted. The entire robotics community will be invited to participate in the book construction and up-date, and so the book will evolve, with their contribution and according to their needs and requirements.

The book organization will avoid render it as a repository of journal papers, a basket of non-organized and isolated contributions or a randomly increasing Web page with random contributions. The RoboticWEBook will have on-line access and will evolve

along time, aiming at keeping an up-to-date repository of material.

2.2 RoboticWEBook CONTENTS

The RoboticWEBook contents will evolve in time, according to the activity of its contributors and bounded by an Editorial Board. However, aiming at keeping some coherence, the items on the first levels of the book list of topics will have to be defined a priori by the Editorial Board. An outline proposal is:

- Components of Mobile Robots
 - Different Robot Classifications
 - Potential Applications
 - Locomotion
 - Robot Sub-Systems
 - Mechanical
 - Energy
 - Communications
 - Sensors
 - Robot Examples
- Kinematics and Dynamics
 - Fundamentals
 - Differential Kinematics
 - Dynamics
- Mobility and Locomotion
 - Wheeled Robots
 - Wheel Model
 - Aquatic Vehicles
 - Flying Vehicles
 - Space Robots
- Actuators and Energy
 - Motors and Servomotors
 - Transmissions
 - Power Electronics
- Sensors and Sensor Technologies
 - Active Sensors
 - Passive Sensors
 - Sensors for Perception
 - Visual Sensors
 - Sensors for Positioning
- Vehicle Modeling and Identification
 - Co-ordinate Systems
 - Identification of Vehicle Parameters
 - Complete Vehicle Model
 - Model Validation Techniques
- Sensor Fusion Techniques
 - Fundamentals of Estimation
 - Uncertainty
 - Multi-model sensing
- World Model Representation
 - Multi-dimensional Representations
 - Multi-scale Representation
 - Multi-modal Representation
 - Active Sensing

- Localization and Map Building
 - Localization Techniques
 - Terrain and Space Representations
 - Geometric Representations
 - Topological Representations
- Path Planning and Motion Planning
 - Path and Trajectories
 - Operational and Joint Space Trajectories
 - Dynamic Scaling of Trajectories
- Guidance and Control
 - Control Problem
 - Control Architecture
 - Force/Position Control
- Task Planning
- Human-Robot Interface and Tele-Robotics
- Simulation
 - Introduction
 - Sensor Simulation
 - Actuators Simulation
 - Simulation of Dynamic Systems
- Cooperative Robotics
- Applications and Case Studies

This list may evolve in time, and the editorial board may accept suggestions for new topics or sub-topics.

3. RoboticWEBook ORGANIZATION AND IMPLEMENTATION

The RoboticWEBook will have an Editor-in-Chief chosen among the members of an Editorial Board. The main foreseen responsibilities of the Editorial Board are:

- To choose the Editor-in-Chief,
- To agree in the initial list of topics to be covered and the corresponding hierarchy,
- To define the revision process for the submissions,
- To define the call for contribution process,
- To implement the revision process.

An Executive Board will assist the Editorial Board, being responsible for posting the accepted material and for keeping an updated version of the RoboticWEBook.

The book will be placed in a unique Web site, even though it might be mirrored. Contributions to the book are under the initiative of any volunteer, probably triggered by invitation or by a call for participation from the Editorial Board. At the initial stage the Editorial Board will discuss the general list of topics to be covered and its organization. Since this book is a result from volunteer contributions it is expected all contributors might participate in a referee process, coordinated by the Editorial Board, to assess the quality of the posted material.

Contributions may have different formats, ranging from tutorial material, comments/revisions/improvements to

posted material, suggestions for a new topic or sub-topic in the book index, comparisons of several approaches to a given topic, implementations.

A ranking procedure launched among contributors and readers, and where the editorial board will play the role of a moderator. This way, this electronic book will receive contributions from the entire interested robotics community.

The issues to be defined and resolved for the RoboticWEBook to be successful are those of *ownership* and *quality control* of the material. Eventhough each author will own its own contribution, the book will be most successful if it is felt to be owned by entire robotics community, in the style of an Open Source Software project. If this is achieved, the potential number of contributors will be vast and to maintain effective quality control it will be necessary for the Editorial Board to scale linearly with the number of contributors.

Some trial software for hosting the book has been developed at the University of Edinburgh and is under test.

4. SUMMARY

This article presents a proposal for an electronic book (the RobotWEBook), to be available for robotics' community by Internet. The RobotWEBook is an initiative under way within EURON-European Research Network. The main goal is to start a structure to compile contributions from the robotics research community to do a web compendium with a collection of tutorials on essential topics on robotics, with emphasis in mobile robotics. To provide also, a complete description of methods and applications of robotics methodologies covering the main topics on practice and research, including results in real experiments.

The compendium will compile a set of links to related material (papers, thesis, reports, virtual labs, emblematic research projects) and it will be a repository of public domain and shareware software for robotic applications.

REFERENCES

- [1] CVonline, University of Edinburgh, <http://www.dai.ed.ac.uk/CVonline>
- [2] <http://webbook.nist.gov/chemistry>

[3] <http://www.ceramics.nist.gov/webbook/webbook.htm>

[4] <http://isp.msu.edu/AfrLang/hiermenu.html>

[5] Math Archives, <http://archives.math.utk.edu/>

[6] J. Borenstein, H. R. Everett, L. Feng, "Where Am I? Sensors and Methods for Mobile Robot Positioning", Technical Report of the University of Michigan, 1996.