

# A CONTENT MANAGEMENT SYSTEM FOR COURSES ON ANALYSIS, MODELLING AND SIMULATION

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**Abstract.** This contribution deals with the development of a content management system for web-based e-learning applications and courses in the field of analysis, modelling and simulation. The current remote learning environment consists of a web server running MATLAB 2006a and a frontend written in PHP. Current work in progress is the development of a content management frontend, which will provide enhanced functionalities, the possibility to organize and group examples, and a user-friendly administrative backend.

## 1 Motivation

Back in the year of 2006 the Department for Analysis and Scientific Computing of the Technical University of Vienna decided to implement an e-learning system tailored for courses on analysis, modelling and simulation.

After a survey of current state of the art technology, the decision was made to use the web server environment included in MATLAB2006a. MATLAB, developed by Mathworks, is a well-known and wide spread computer algebra package with many additional toolboxes.

The main intention and requirement of the designed MATLAB e-learning environment is to visually present mathematical systems and dynamical models as additional demonstrative material for specific courses and lectures. With the aid of the platform students have the possibility to experiment with prepared examples and models by changing certain predefined model-dependent parameters. The demonstration examples within the platform support the lessons with visual and experimental aids and intensify the knowledge gained through the course lectures and lecture scripts.

This work deals with currently ongoing further developments of the existing e-learning environment, in particular with the development of web-based content management system as a replacement for the currently used static PHP-frontend. It also gives an short outlook on future development and enhancements possibilities.

## 2 Current MATLAB E-learning Environment

The existing frontend is programmed in PHP using several files for configuration purposes and parameter input. The examples provided are written in MATLAB.

Examples can be administered by editing the PHP and configuration files. Access control and user management is realized with HTACCESS authentication. For adding new examples and editing files SCP or SSH access is used by lecturers and administrative users.[1]

```

<?php
    $pageVars['ml_mfile'] = 'example_000';
    $form = new Form();
    $form->addField(new FloatField('var1', 'Starthöhe:',
10, 0, 100));
    $form->addField(new FloatField('var2', 'Startwinkel
in Grad:', -45, -89, 89));
    $form->addField(new FloatField('var3', 'Startge-
schwindigkeit', 1, 0, 100));
    $pageVars['form'] = &$form;
?>

```

Figure 1. Input Parameter Configuration File

The current frontend has no database backend. Example description, input parameters, title and additional information regarding examples are stored in the file system.

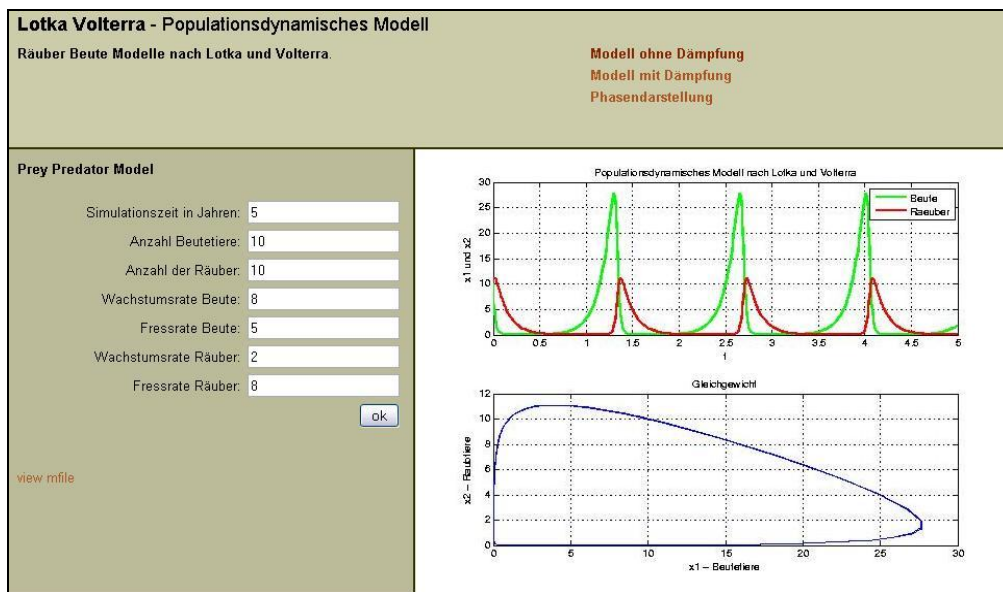


Figure 2. Current Matlab Elearning Frontend

### 3 Content Management System

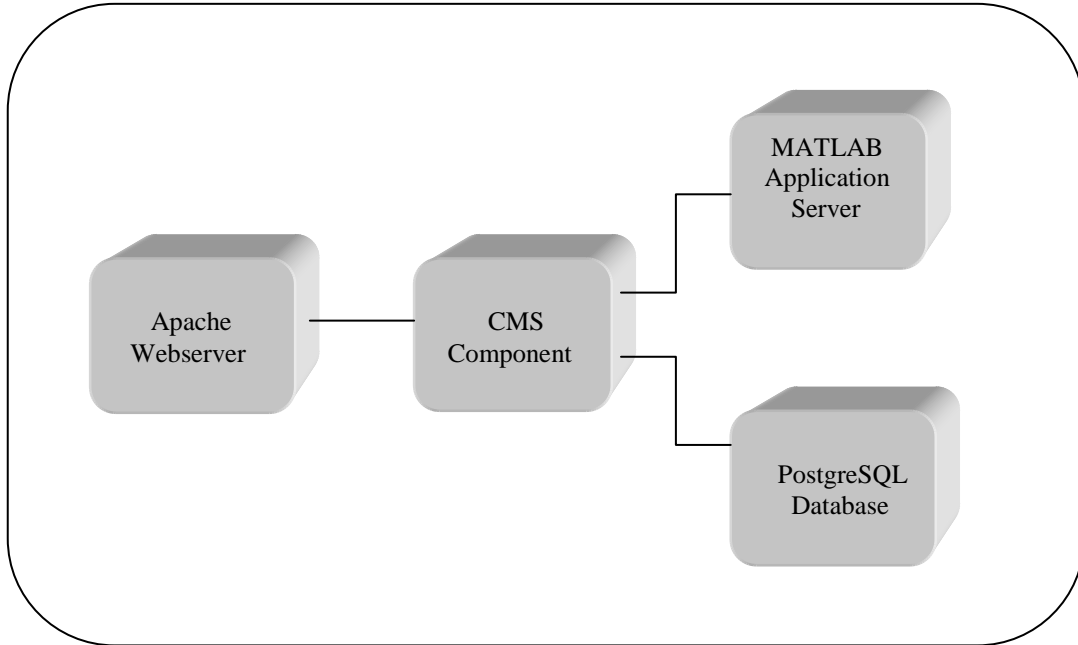
A web-based content management system is software implemented as a web application, designed for creating and managing content control, editing and essential web maintenance functions.

Web CMS usually provide authoring facilities especially designed to allow users with little or no knowledge of programming or markup languages, such as HTML, to create and maintain web content with relative ease of use. Most systems use a database to store content and metadata, and artefacts or resources needed by the system. Content is often stored as XML, to facilitate reuse and enable flexible presentation options. [2]

Key features and common characteristics of web-based CMS:

- .) Use of templates pages
- .) Easily editable content
- .) Workflow and document management

Current work in progress, developed by the modelling and simulation workgroup of the Institute for Analysis and Scientific Computing of the Technical University of Vienna is a Content Management System, which provides an easier-to-use example management and more options regarding language of the explanation texts, parameter names and composition and organisation of examples.



**Figure 3:** System Components of the Matlab Elearning Environment

The CMS is the user interface component. It is implemented in PHP, but unlike the current PHP frontend which stores all of its data within several text and configuration files, the CMS data is stored within a PostgreSQL [3] database. In detail the database is used for storing configuration data, user data and information regarding the examples' resources, such as descriptive texts, parameters, pictures and of course the used example source files.

### 3.1 Example Structure

Adding new demonstration examples is possible directly via the web interface. Examples can easily be grouped in categories, chapters and courses to provide a structured view for both students and administrative users. This helps to keep track of the huge number of examples, which has grown steadily over the last two years. Administrative users can add new categories and group similar examples into certain categories.

### 3.2 User Management and Access Control

User management and access control data is provided by the database structure. The right management system includes personalised user rights as well as group rights. The current system permission management is done via HTACCESS files – one HTACCESS file for each example chapter.

In the CMS a different database-based right management and permission system will be implemented, which differs between administrative users and course users or students. The students are granted access permissions on certain examples or groups of examples.

### 3.3 Editing Options and Parameter Input

The editing facilities used for managing the e-learning content are simple and tailored to the specific needs of the system, e.g. parameter input, online editing of the examples source code.

The editor for parameter and text input is a very simple and straightforward one, tailored to the systems specific requirements. The editor provides basic formatting options. The integration of existing editor components, such as TinyMCE [4], has not been considered.

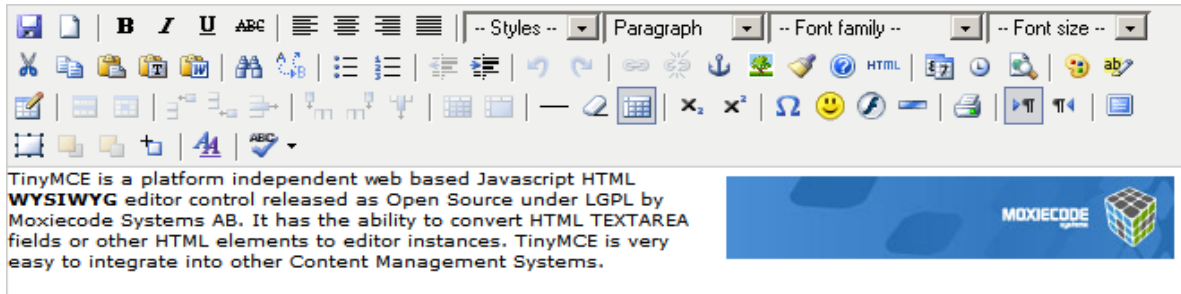


Figure 4: TinyMCE Editor Screenshot

The ones evaluated during requirements analysis tend to have an overhead of functionality, e.g. emoticons and color formatting support, and do not fit most the systems core requirements, although most of them would have been easy to integrate.

The MATLAB source files can be edited by administrative users directly via the CMS' graphical user interface. The editing can be done via online editing directly in the CMS interface. In addition to that it is also possible to download the files on the local machine for editing and upload existing files via the CMS' graphical user interface again.

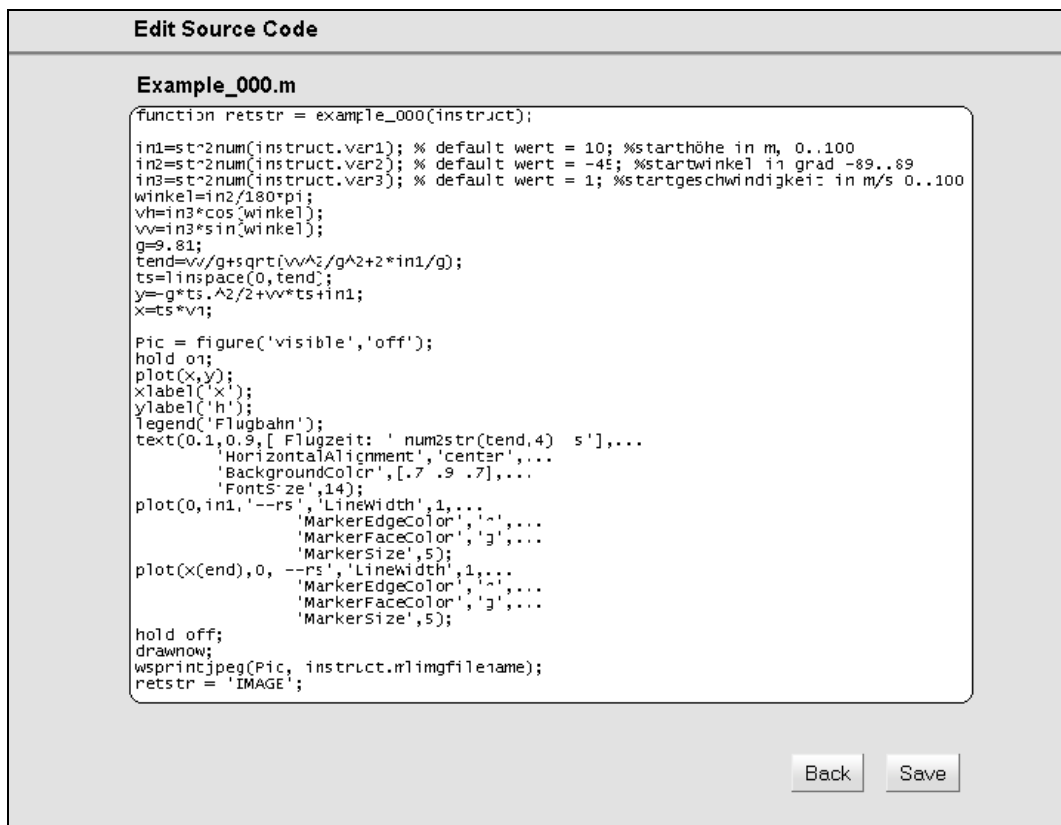


Figure 5: CMS Source File Editor

### 3.4 Data Model

Figure 6 shows the simplified data model of the CMS:

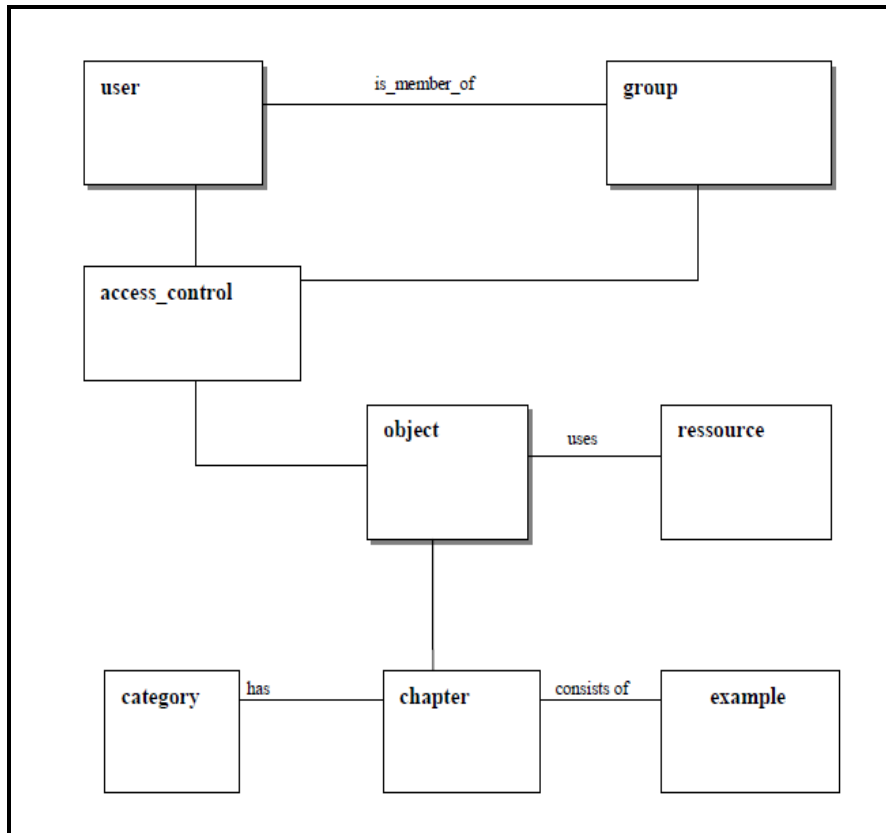


Figure 6. CMS data structure

Users are organized in groups and can be member of one or more groups. Users and groups have certain permissions on data objects in the system. Each object uses certain resources such as MATLAB source files or graphic resources, e.g. jpeg-files or bitmaps.

One or more examples are part of a chapter. Categories usually consist of chapters of the same field of application, type or similar content. Administrative users organize similar chapters in categories via the graphical user interface.

### 3.5 Database Persistence

To assure data persistence and to allow comfortable database access the EZPDO [6] is used as database persistence component. EZPDO is a light-weight persistence library designed for PHP5.

### 3.6 CSS Templates

Cascading style sheets (CSS) [7] is a template language used to describe the presentation of a document written in a markup language. The MATLAB e-learning CMS uses CSS to define their HTML templates.

Colours, fonts and the general layout of the CMS pages are defined within CSS template files.

By combining CSS with the functionality of a CMS, a considerable amount of flexibility can be programmed into content submission forms. Another advantage is that application-wide consistency of the layout is guaranteed. A global style sheet is used to affect certain style elements side-wide.

CSS style sheets support another common design philosophy: separation of presentation and content.

Business logic code parts and the presentation layer are separated from each other to provide a better overview and in some cases easier reusability of certain code components.

## 4 Summary and Outlook

The intention is to create an easy-to-use, more structured and flexible environment, which allows editing and organizing of the existing e-learning examples. A content management system, in principle, has certain advantages in comparison to plain static web content: It is more flexible, designed to manage digital content. It allows users, who are not familiar with programming or markup languages to edit content without touching of source code files and HTML pages.

The future e-learning environment should not only support MATLAB [8] content, but also examples and demonstration models written in other server-based programming languages, e.g. JAVA servlets, Octave [8] and Maple content. This has already been considered in the requirements analysis and design of the content management system. The CMS frontend is open for integration of other backend applications and several future development approaches.

## 5 References

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