The SIMSPOG simulation tool: a web-based implementation

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Abstract

Predicting the system behaviour of traction power supply systems, earthing systems and track circuits has become of vital importance to the railway community. The availability of computer based calculation tools is a precondition in engineering studies in the field of electrical systems compatibility (ESC) and electromagnetic compatibility (EMC). Also the sharing of information amongst multiple parties involved in activities on a single segment of infrastructure has become more and more important with increasing complexity of systems. Multiple cases have demonstrated this need for cooperation.

As a first step to enable sharing of simulation models, “Holland Railconsult” and “Institut für Automatisierung und Informatik Wernigerode” have converted the existing SimspoG simulation tool to a web-based package. The SimspoG simulation tool, being able to calculate current distributions within the railway system on the basis of transmission line models, makes it possible to study conductor rating, track circuit models, current distribution, system resonances and effectiveness of earthing systems.

The newly designed web-implementation makes it possible on the one hand to access the tool through the Internet by a common Internet Browser, but on the other hand to access the tool by different web-based SimspoG application components. Discovering the possibilities of XML saved structured data inherits preparation of a unique simulation model format to store physical transmission line data and models to be an add-on for special markup languages. The server software is implemented in a Linux environment using a Tomcat Servlet engine as a container for the application modules.

The implementation of the SimspoG web-package has provided Holland Railconsult with a flexible simulation server, suited for multiple users/specialists in the fields of traction power supply, EMC, ESC and signalling.

Keywords: ESC, EMC, power supply, signalling, Internet, web service, servlet, Java, XML.
1 Introduction

Since 1994 simulations and measurements on the behaviour of AC traction power supply systems have been made by Holland Railconsult. Also its influence on signalling and telecommunication systems as well as on existing railway infrastructure and third parties has been studied.

In the course of this process the necessity to have a dedicated simulation tool available became clear. After several years of development, a useful simulation tool is now available [1].

The basic single-user SimspoG-implementation uses the Matlab-calculation package, including the available user-interface, to set-up the calculation models. The actual calculations are done by a so called Matlab MEX-function, written in C code, that uses the GMP library [2].

To create a more user-friendly environment to be used by a wider group of users, a first web-based implementation was created using CGI-Perl-technology on a common Linux-PC. Accessible through the Internet by a common browser, this prototype enabled users to vary a pre-defined number of model parameters through a HTML-form. This form was processed by a CGI-script and calculations done by Octave using also the GMP library.

2 General description

The good experience gained with the prototype has induced the wish to develop a more flexible and user-friendly web-server application. Reason why Holland Railconsult has contacted the Institut für Automatisierung und Informatik GmbH Wernigerode to assist in the development of this web-server application.

It was agreed that on the basis of OpenSource-applications both the server-architecture and the calculation-program implementation would take place.

2.1 Requirements

On the basis of the experiences gained with the prototype implementation a list of requirements for the new web-server application has been arranged. The main requirements to be addressed are:

- multi-user environment with controlled access-rights;
- multi-processor/system scheduling for calculation processes (master/slave-structure);
- user-interfaces for online construction of calculation-models, online parameter control, online documentation;
- consistent datamanagement in a safe database-system, both for the user-models as for the model-components;
- numerical accurate calculation of the simulation-models;
- consistent presentation of the calculation results for further processing;
- development of a control-panel for simulation status control.
3 Implementation

Based on the requirements agreed and the experiences gained an architecture for the SimspoG-Web-server has been realised.

The Master-Web-application is based on a Tomcat-Servlet-engine. It realises 2 main functions (see figure 1):

- SimspoG-User-Service & Calculation-Service.

![SimspoG web-server-architecture realised.](image)

Due to multi-user aspects a special SimspoG-Web administration service will be offered by an administration module to modify user data or to maintain the SimspoG-Web database.

**Master-slave**

The scheduling of the calculations is realised by a simple algorithm on the basis of a master-slave structure. The calculation of simulation-models on the regular x86 PC's takes in the majority of the cases a substantial execution time. There is however the opportunity to distribute the calculation of multiple calculation tasks to different systems. Although in the future modularization of the processes and process-control could be developed further, the current application can distribute multiple tasks as a whole to the calculation modules. When a request for calculation is done, the master assigns this task to an idle slave-module, which processes this tasks autonomously. It is to the system manager to decide on the number of calculation models to be assigned to individual systems/PC's.

**3.1 SimspoG-User-Service**

The SimspoG-User-Service handles all the requests done by the clients/users to the master, offering a Internet based neutral interface between user and platform.
The implementation of the interface to the SimspoG-web-application has been done on the basis of HTTP and SOAP (SOAP: simple object access protocol), which is a useful choice when applications are activated in a decentralised and distributed environment like the internet. In the view of the developer of the SimspoG-modules this implementation offers an interface definition for the SimspoG- and Master-Slave-Web-Service in WSDL (WSDL: web service description language).

![Figure 2: SimspoG User-GUI browser-window.](image)

In figure 2 the browser-window for the SimspoG User-GUI as realised is shown. The majority of the screen is dedicated to the online parameter control as the left side shows the status of the calculation tasks.

### 3.2 Calculation-service

The master-slave service is implemented through the calculation service. The Servlet-engine of the master manages the slaves registered to the calculation network. Once a slave has registered itself to the master, the master controls the communication and status-check of the slave. In case of loss of communication to a slave the master reassigns the calculation task to another slave.

The simulation data is handed over to the slave in a XML-format and transformed to the calculation data-format using XSLT (XSLT: extensible stylesheet language transformation).
4 Conclusions

The newly designed web-implementation makes it possible to access the SimspoG tool through the Internet by a common Internet Browser. The SimspoG User application interface implementation allows to input or modify different simulation model parameters and starting of simulation processing.

Based on a revised XML simulation model, a designer view will be developed to design and modify simulation models and simulation model data in a graphical manner.

The future calculation system foreseen is shown in figure 3.

Figure 3: SimspoG web-server architecture to be implemented.

The implementation of the architecture, developed for the SimspoG tool, is however not limited to the specified task, but also suited for many other applications. It has made online graphical user interfaces available to specialists in the fields of traction power supply, EMC, ESC and signalling.

In the future the SimspoG-web-service will make a flexible calculation system available to Holland Railconsult with the following features:

- multi-user environment;
- service for user transparent calculation scheduling;
- XML conformity in data format;
- uniform WSDL service interface.

The simulation model schemes will be proposed to integrate them as a working draft document to an international standard markup, for example RailML.
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References
