

## REMOTE CONTROL AND MONITORING IN THE SIMULINK

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**Abstract:** This paper describes a created application, which allows remote control and monitoring of technological processes using Simulink. Developed application SimWebLink can be just a simulation or control of a real system. SimWebLink application enables remote monitoring and control processes using a common Web browser supporting JavaScript. The new TCP/IP block sends out data from model using the TCP/IP protocol.

**Key words:** remote control, monitoring, Simulink, TCP/IP

### 1. INTRODUCTION

An emerging strategy for application software is to provide web access to software previously distributed as local applications. Depending on the type of application, it may require the development of an entirely different browser-based interface, or merely adapting an existing application to use different presentation technology. In software engineering, a web application is an application that is accessed via web browser over a network such as the Internet or an intranet. It is also a computer software application that is coded in a browser-supported language (such as HTML, JavaScript, etc.) and reliant on a common web browser to render the application executable. Web applications are popular due to the ubiquity of a client. The ability to update and maintain web applications without distributing and installing software on potentially thousands of client computers is a key reason for their popularity. One of the possible application which offers advantage of high performance tools for calculation and simulation is program MATLAB/Simulink.

MATLAB Web Server was the first application taking significant advantage as web applications using MATLAB. The MATLAB Web Server enables the creation MATLAB applications that use the capabilities of the World Wide Web to send data to MATLAB for computation and to display the results in a Web browser. As of MATLAB Release 2006b, this toolbox was discontinued and is no longer available for purchase (MATLAB inc., 2001).

At the Tomas Bata University in Zlín has been already developed an application called MatlabLink. The aim of this application was a remote control and monitoring of technological processes using Matlab. When control of real laboratory model was used by the Real Time Toolbox of Humusoft company. Unfortunately, after upgrading to the latest version of the Matlab and Real Time Toolbox, problems have occurred since RT Toolbox was discontinued support for the command line of Matlab and are still only supported by Simulink block diagrams. The structure of the program proposal MatlabLink not allow links to Simulink, thus began the development of a new version that allows monitoring and control processes directly on the principle of TCP/IP network communication. The new application was called SimWebLink. Although the functionality is already present the proposed settlement, the application is still in the developmental stage.

### 2. APPLICATION STRUCTURE

SimWebLink application enables remote monitoring and control processes in Simulink using an common Web browser supporting JavaScript. The advantage of this application grows with the runtime of the process, behavior can be monitored remotely. The whole conception is based on the idea, when one computer control a technological process by a program written in MATLAB/Simulink then from other computers with internet connection is possible to monitor and partially also control the running measurement. The number of the computers that are able to monitor the technological process is not theoretically restricted (practically it is limited only by the server performance). The control commands are accessible only for one computer. It is possible to restrict both actions (monitoring and control) by access password.

Application SimWebLink consists of four parts, which are further described in the text below. Communication scheme of each parts of the application is shown in the Figure 1. SimWebLink parts are written as multithreaded application, communication is via TCP/IP sockets (MATLAB inc., 2008).

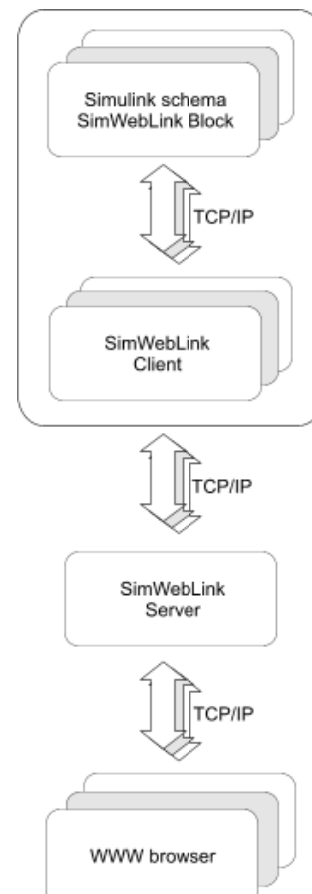


Fig 1. Application scheme

## 2.1 SimWebLink Block

The TCP/IP block sends out data from model using the TCP/IP protocol. This data is sent at fixed intervals during a simulation. The TCP/IP client block has one input port. The size of the input port is dynamic, and is inherited from the driving block. This block has no output ports. The developed TCP/IP output block is shown in the figure 2.

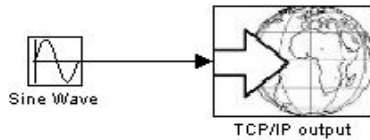


Fig. 2. The TCP/IP Client Block

The Sink Block Parameters dialog box can be used for selecting communication parameters (Figure 3).

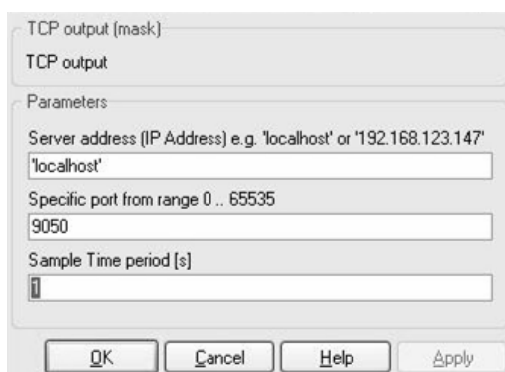


Fig. 3. The TCP/IP Client Block Parameters dialog box

It is possible to specify a remote server address, port and sample time period. The sample time period is the rate at which the block send the data to specified port on the server during the simulation. It is possible use more than one TCP/IP output block to obtain more chart figures.

## 2.2 SimWebLink Client

Part SimWebLink Client have to be run on the computer where is accessible the program Matlab/Simulink and laboratory task is attached. The main objectives of this part of the application can be described in four points:

- Contact SimWebLink Server after start and announce readiness to work.
- Expect control commands from SimWebLink Server.
- In the event that comes the command to run Simulink schema, configure parameters and run the Matlab engine.
- Expect the incoming data from the SimWebLink Block and than immediately forward them to the SimWebLink Server.

This part of the application is written as a multithreaded program (Bradford et al., 1996) which communicates via sockets (Microsoft Corporation, 2009). This layer of the entire application is required just only for remote control and has the benefit of placing measuring computer in the private network; the public IP address is not required. In the case of monitoring, TCP/IP Output Block can send data directly to the SimWebLink Server or to another application (or device).

## 2.3 SimWebLink Server

Server part of the application registers the connected clients, receives data from them and prepares them for display

in a WWW browser. The incoming data are stored in the MySQL database and the chart figure is generated. SimWebLink Server also expected to control commands from the user, which is entered by web browser. This part of the application is written as a multithreaded, for each connected client is reserved just one thread, which is dynamically created when a client connects. Number of connected clients can be restricted according to the performance of the server. All communication is via sockets.

## 2.3 SimWebLink Web Part

Web part of the application is written by PHP on the web server side and uses HTML, CSS, JavaScript on the client web browser side. The displayed charts are updated on-line using AJAX. All communication with SimWebLink Server is via sockets.

## 3. CONCLUSION

An emerging strategy for application software is to provide web access to software previously distributed as local applications. It requires the development of an entirely different browser-based interface and adapting an existing application to use different presentation technology. This paper describes options for making MATLAB/Simulink applications available via the Web and the new developed web application called SimWebLink. SimWebLink extends computation possibilities of the MATLAB/Simulink. The application SimWebLink is a multithreaded and a multiplatform application.

The whole conception is based on the idea that it is possible to observe running simulation or real measurement results in the web browser. The data presentation lag is minimal and SimWebLink Block does not affect Simulink schema runtime too much. The main advantage is a remote control and monitoring from any web browser in the Internet. The presented data are stored in the database for the later uses.

SimWebLink is suitable for a remote control and monitoring of the technological process uses MATLAB/Simulink via Internet. The development of the application still continues and new operating functions will be implemented.

Developed Simulink TCP/IP Output Block can be used in Simulink models to communicate with others applications and devices over TCP/IP network.

## 3. ACKNOWLEDGEMENTS

This work was supported by the Ministry of Education of the Czech Republic under grant No. MSM 7088352101.

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