

Remote Process Control and Monitoring Using Matlab

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Abstract - This contribution presents remote process control and monitoring. The developed application MatlabLink enables to access Matlab applications via Internet. MatlabLink uses the capabilities of the World Wide Web to send data to Matlab for computation and to display the running results in a Web browser. The running results are accessible via Internet. Using program Matlab for control on the distant computer is the keynote of remote control of laboratory technological processes. Let's assume technological process controlled by Matlab program on the first computer (no matter what - simulation or real laboratory plant). It is possible to command and monitor this one by any computer in the Internet network. Just only one computer can command this process, monitoring is accessible to arbitrary number of computers. This system uses client/server architecture. Proposed solution considers contact server which allows communication with computers in private network. The remote control of simulated processes works perfectly; the functionality of the remote control of the real processes is tested in these days.

Index Terms - Remote control, Matlab, Laboratory models

INTRODUCTION

Program Matlab is a software package that allows data to be analyzed and visualized using existing functions and user-designed programs [4]. Using program Matlab for control on the distant computer is the keynote of remote control of laboratory technological processes. Let's assume technological process controlled by Matlab program on the first computer (no matter what - simulation or real laboratory plant). It is possible to command and monitor this one by any computer in the Internet network. But just only one computer can control this process, monitoring is accessible to arbitrary number of computers. This system uses client/server architecture. Proposed solution considers contact server which allows communication with computers in private network.

Diagram on figure 1 is generalized about three different networks, but can operate on just only one network. This architecture allows concurrent run of several technological processes in different local networks, users can access WWW server with public IP address from any network.

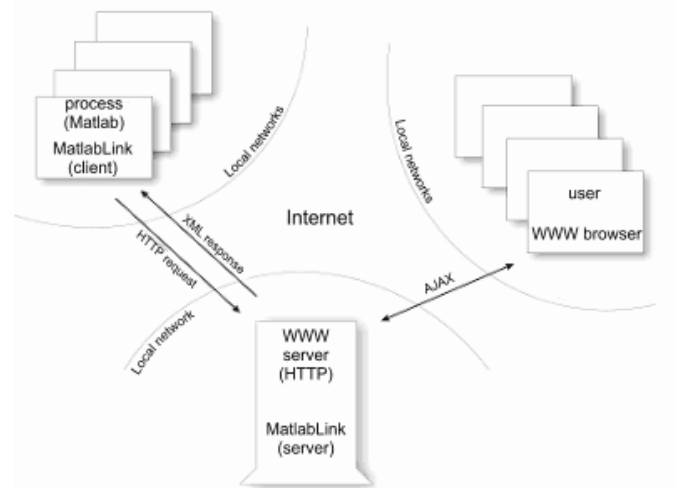


FIGURE. 1
COMPLETE COMMON DIAGRAM

MATLABLINK

The whole application consists of several subsystems and makes use of several different technologies in this time.

- **JMatLink** – Library, which allows Matlab connection with Java [1]. By the instance of a JMatLink class is possible to start up program Matlab, execute commands and obtain state of the Matlab workspace.
- **MatlabLink** – Application that runs on the same computer where program Matlab is installed. This part is written in Java and uses JMatLink library. MatlabLink periodically executes main control, reads variables from workspace and communicates with server [2].
- **MatlabLink Server** – Presents a server part of application MatlabLink. MatlabLink server communicates with MatlabLink clients and stores communication on the server.
- **MatlabLink Web** - This part works together with MatlabLink server. HTML and JavaScript code generated by this part is sent to the user web browsers.

I. Design and Structure of Matlab Application

Matlab application commonly consists of several m-files. There is necessary initialize variables, define starting conditions and load drivers in the beginning. Next, process control proceeds in defined calculation loop. Finally, application should be proper finished (for example unloads drivers) otherwise we can expect undefined state or controlled system damage. Developed application for remote control - MatlabLink - requires specific structure of m-files which is based on above mentioned behavior. Matlab application should consist of three parts; each of parts can consist of arbitrary number of m-files. The name of the m-files is not strictly specified.

- The repetition rate should be defined in the first part and the name of this variable should be defined in the configuration file (XML format).
- The second part presents process control. MatlabLink provides periodic execution of this file. This file can call another m-files or functions. This file should be periodically executed by MatlabLink, because Matlab does not offer content of workspace during execution.
- The last part is executed after completing control loop and provides proper termination and disconnection of hardware.

II. MatlabLink Web

The figure 2 shows the part of the interface of the MatlabLink Web which is accessible via web browser. The running processes are listed in the table which is periodically refreshed. The time till the next refreshing is displayed on the top-right part of this table.

Running processes	Time to refresh: 2s
Testing dynamic resistor - Delta	
Delta Adaptive Control - simulation	
Adaptive Control	

FIGURE 2
MATLABLINK WEB.

User can select one of the running processes, after it, the next window will require access password defined in the configuration file. Each of the running process is possible protect with a unique password to guarantee the process is controlled by the authorized user. The password is required just only for the remote control; the monitoring is accessible without any password. If the authorized user is log-in, system does not require the password and the user is automatically redirected to the monitoring page.

The user can see just only permitted Matlab outputs in the monitoring page. The variables (or figures) are displayed in the individual window, they are periodically refreshed. The authorized user moreover gets possibility of command

this process (start, stop, set-up variables, change rate and terminate process).

The Real Time Toolbox for Matlab grants access to hardware (laboratory plants) [3].

CONCLUSIONS

This contribution presents application MatlabLink which make accessible and derive benefit from the computational program Matlab via internet. This application is useable for the remote process control of real laboratory plants. The authorized users can monitor or command the remote process control, the others can just only monitor.

This application was created for remote control of laboratory plants in the laboratory of real processes. It makes possible to utilize an existing m-files, which are currently used for local control of laboratory models. These m-files require small changes described in the section Design and Structure of Matlab Application.

Whole application is suitable only for real systems, which have sampling period bigger than 500ms. Approximately this period is necessary on common computer for data acquisition and their sending to the server.

A lot of different technologies were used for creating of this application, because this work continues previous work. Next version of this application will be completely rewritten to the Java language; it will lead to new conception of whole application. Multithreading concept will be used; contribution of this solution will be in faster data processing. As the newest version of Real Time Toolbox for Matlab supports just only Simulink, next version of the MatlabLink will accept this fact.

ACKNOWLEDGMENTS

This work was supported by the GAČR under grant No. 102/05/0271, and by the Ministry of Education of the Czech Republic under grant No. MSM 7088352101.

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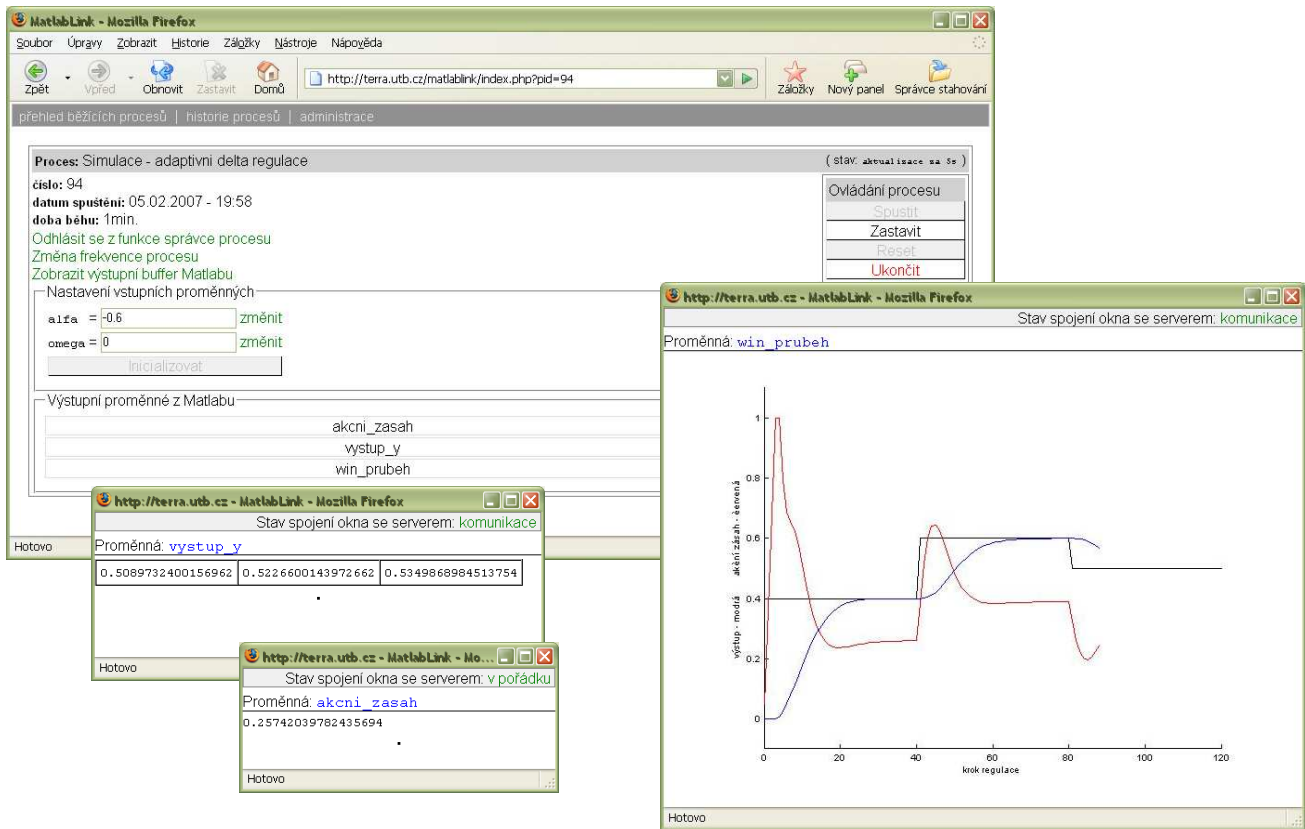


FIGURE 3
MATLABLINK WEB INTERFACE.