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Methodological support for discipline modeling simulation methods

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Introduction

This article presents the result of a workshop being developed with a list of training tasks.

This workshop covers part of the basics of control theory in the course section "Methods of simulation" and contains concepts about numerical simulation models of control systems and their mathematical descriptions.

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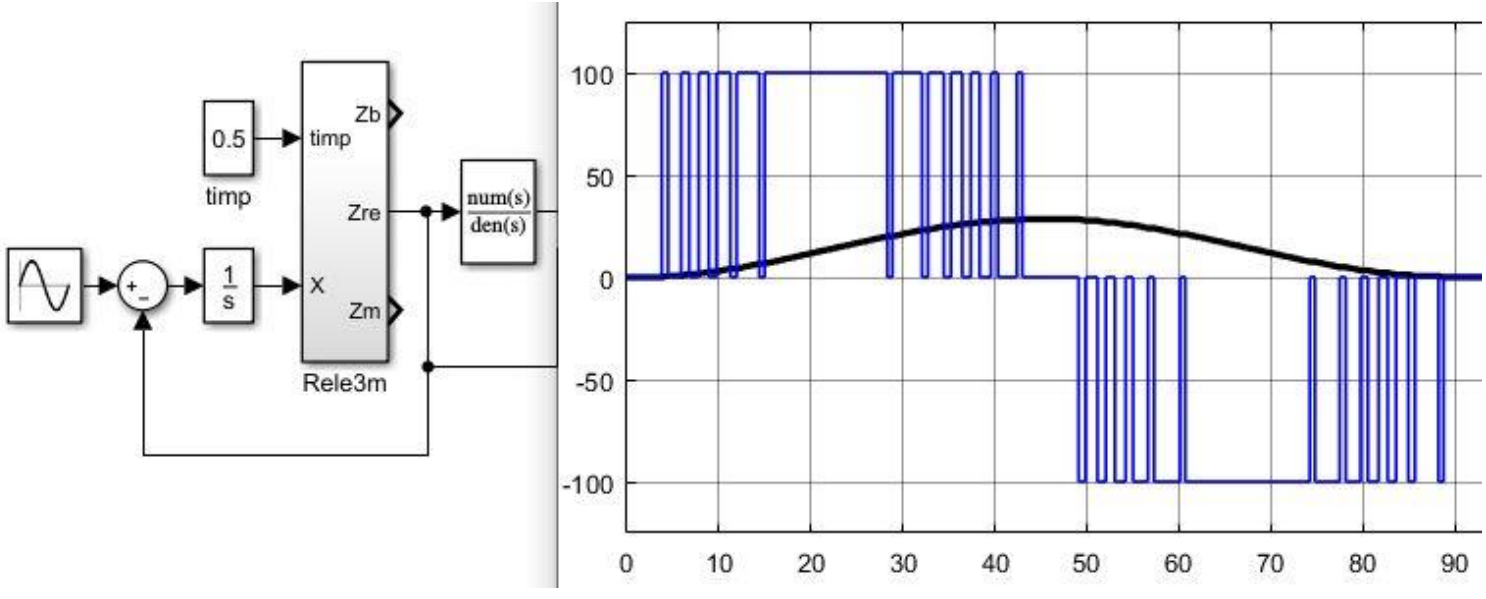
Methods for constructing automatic control systems used in the workshop:

- Graphical simulation modeling environment MATLAB Simulink



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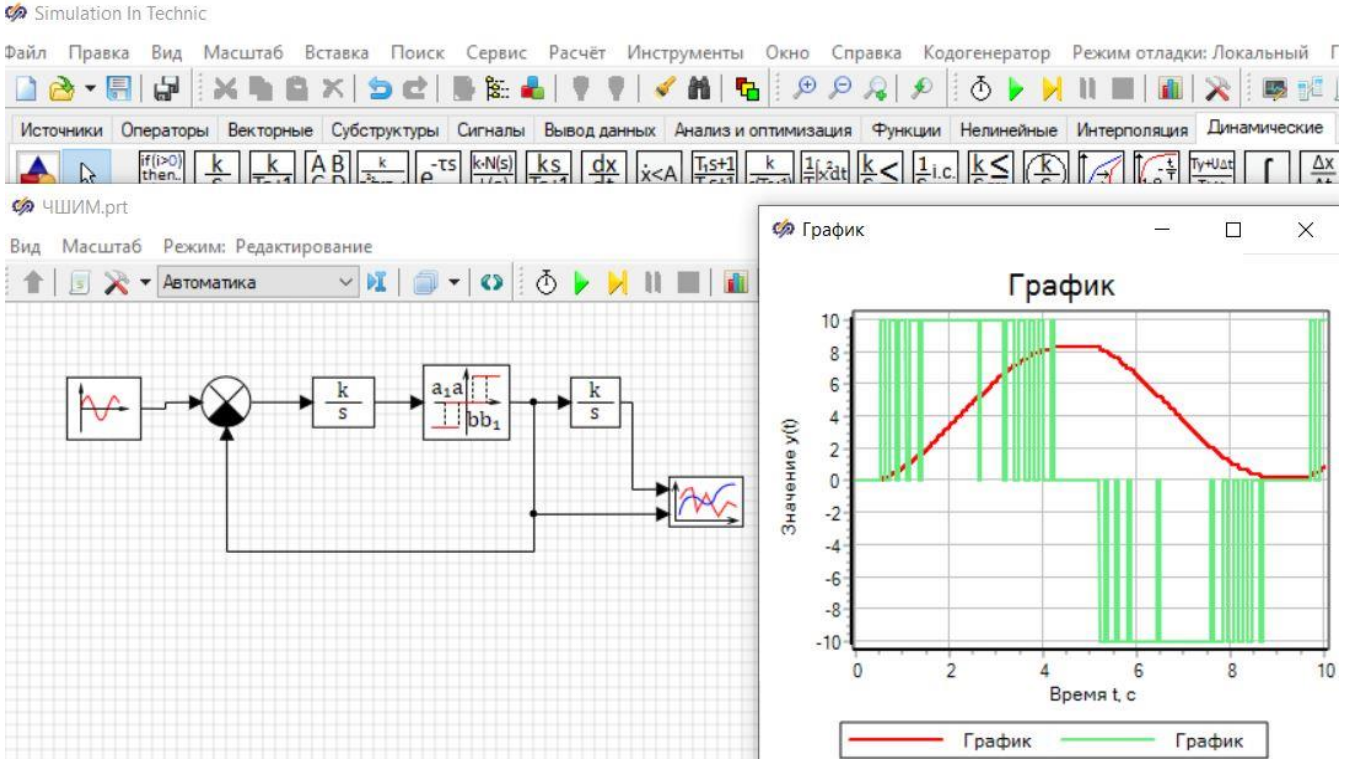
- New Russian model-oriented design system SimInTech



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- Programming methods using the MATLAB language

MATLAB ▸ R2018a ▸ bin ▸ MimLab

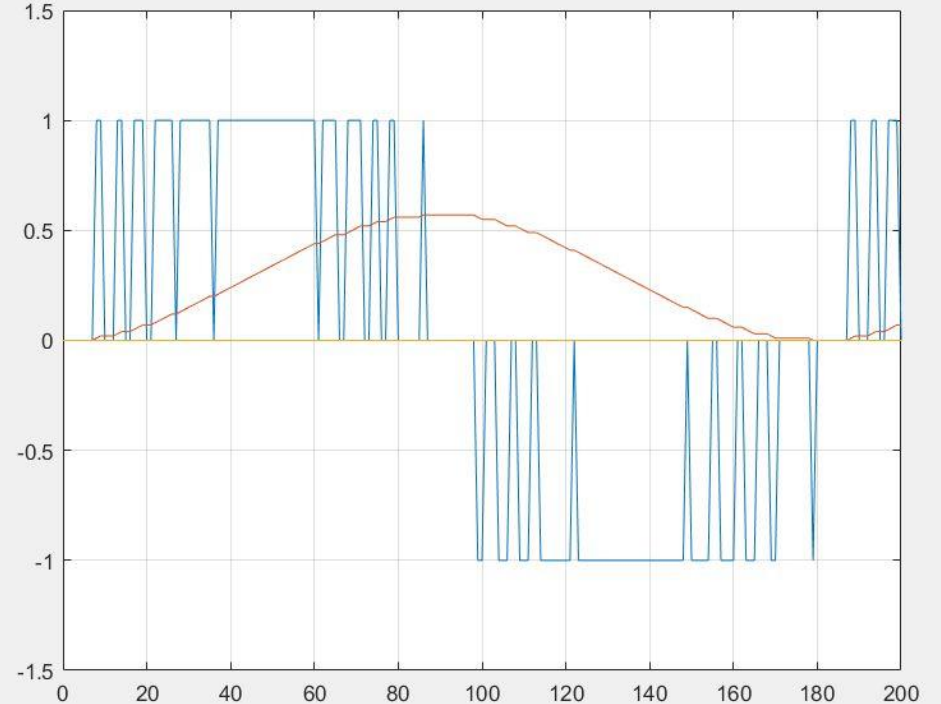
Editor - C:\Program Files\MATLAB\R2018a\bin\

D_zveno.m | Rele_zveno.m | Sin

```
1  function [Y1] = Rele_zveno
2  Y1=0;
3  if X1>=a
4      Y1=A;
5  end
6  if X1<=-a
7      Y1=-A;
8  end
9  if X1<a && X1>=b
10     if Y0<=0
11         Y1=0;
12     else
13         Y1=A;
14     end
15 end
16 if X1>-a && X1<=-b
17     if Y0>=0
18         Y1=0;
19     else
```

Command Window

```
>> SinTest
```



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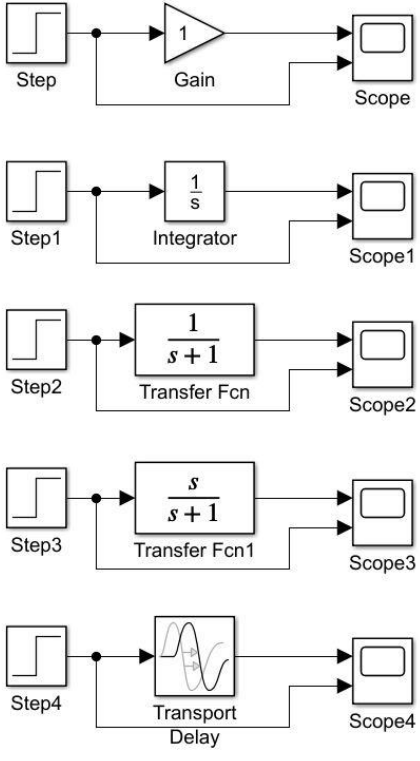
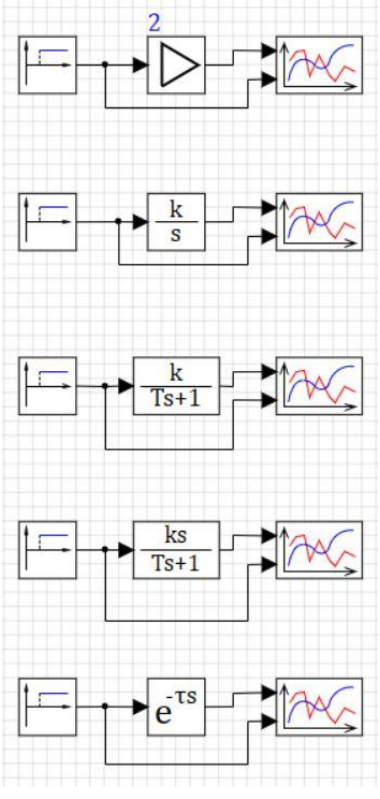
The workshop work cycle consists of three thematic tasks:

- The acquisition of skills in the presented software on the example of obtaining dynamic characteristics of the simplest links and their connections.





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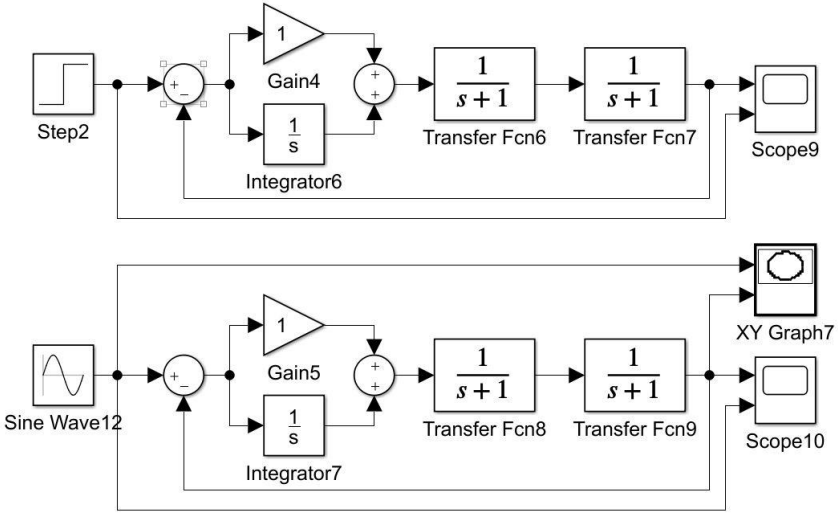
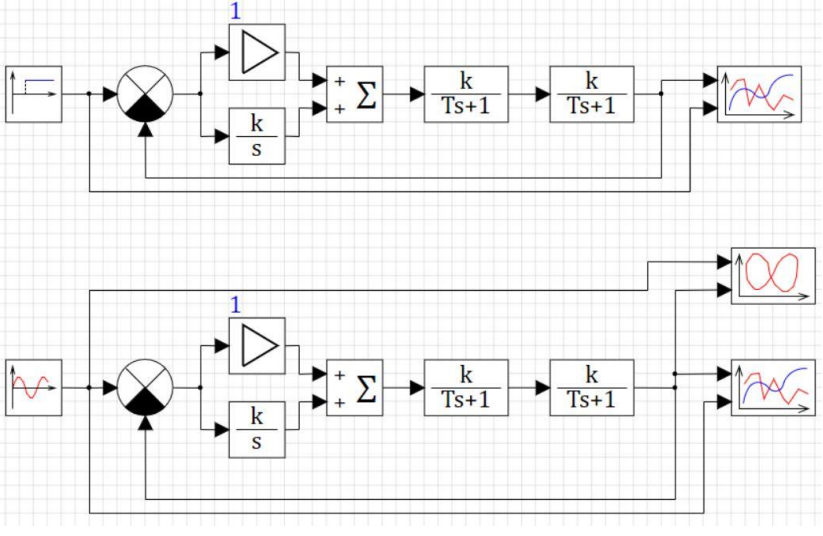
- The study of methods for constructing complex combined circuits and obtaining their dynamic characteristics.





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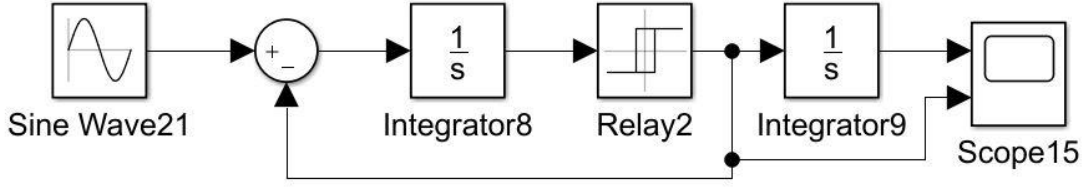
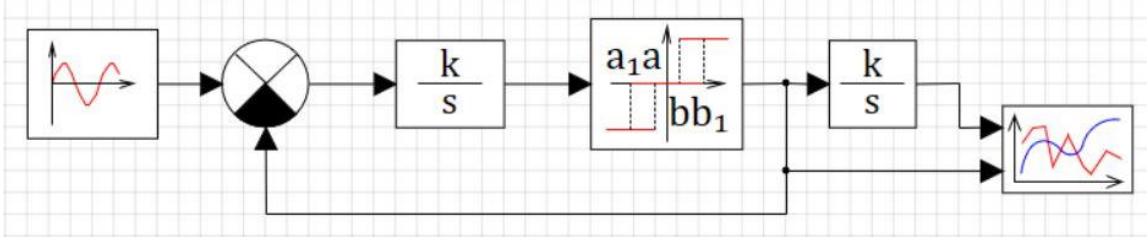
- The study of the dynamic characteristics of nonlinear elements and their combined compounds with the simplest links on the example of a frequency-width-pulse-width (FWPW) modulator.





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Workshop Content

The workshop under development is divided into the following sections:

- Introduction.
- Theoretical part.
- The practical part.
- Application.

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The introduction indicates for which discipline and course this workshop is intended, its features, goals and objectives, a general description of the work process, and also the place where these works are performed.

The theoretical part contains a general description of the software products presented in the papers, the necessary fundamentals of using the software to solve the problems posed in the practical part, with their description and solution methods.

The application contains the source data of the options, as well as the used program code and function blocks in MATLAB.

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The practical part contains a consistent presentation of works that contain:

- Objective.
- General source data.
- The colloquium.
- Tasks.
- Performance requirements.
- Defense Questions.

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The general source data contain a small theoretical part directly related to the work performed, as well as a part of the initial data, which is common to all options.

The colloquium contains questions for checking students for admission to work.

Requirements for the work performance include the necessary conditions for obtaining admission to the protection of these works.

Defense questions may contain questions from the colloquium, provided that additional practical components are used.

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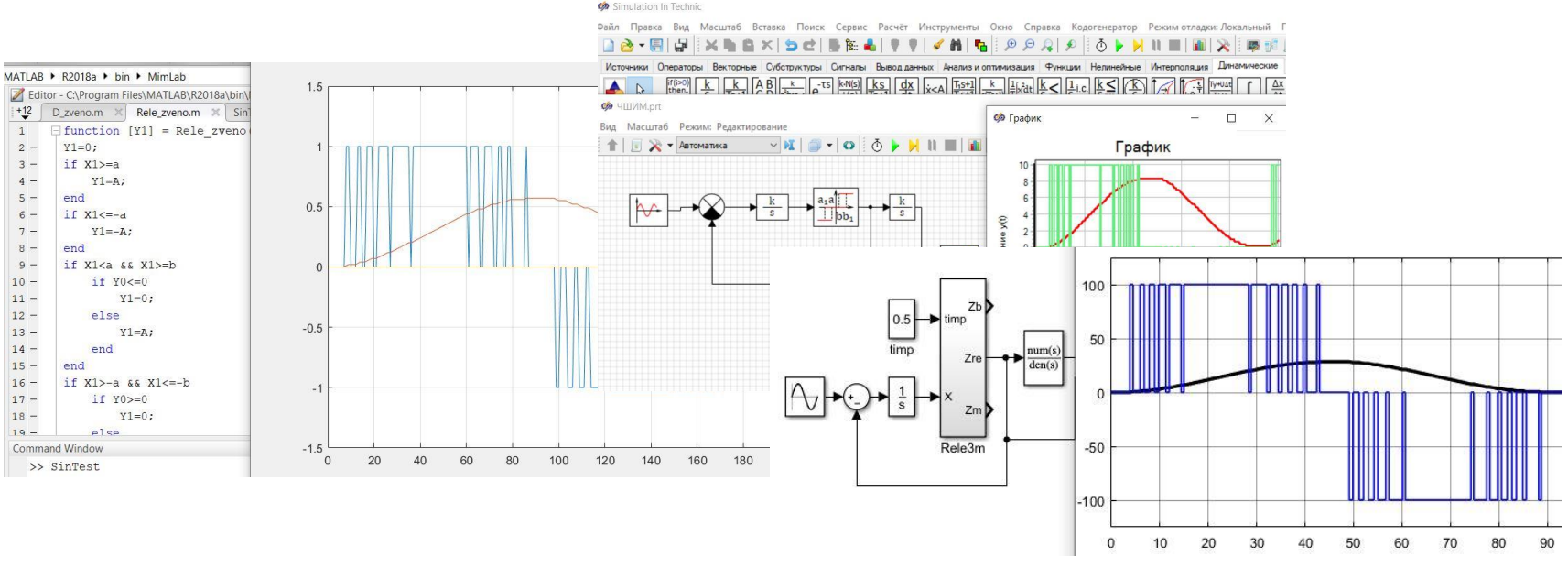
Laboratory Example

This article provides the laboratory work example on the topic: "Pulse-frequency-pulse-width modeling with a sinusoidal control signal."



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In the theoretical part, the general initial data are presented in the form of the required FWPW modulator using a sinusoidal control signal and an integral link.

The colloquium presents questions on:

- The nonlinear elements operation principle.
- A method for simulating a sinusoidal signal.
- Dynamic links quantization.

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The task consists of sequentially performing given system modeling in various programs:

- For the program SimInTech and Simulink:

1. Sequential assembly of the circuit using ready-made blocks from program data libraries.

2. Changing the blocks parameters according to the ones specified in the application.

3. Change the time and phase charts design to improve readability.

4. The removal of the obtained schedules for the subsequent laboratory work execution in the preparation for the defense.

5. Repeat steps 2-4 for other parameters.

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- For a job using the MATLAB language:

1. Preparation of the necessary blocks for the circuit in the form of functions for the main program. These functions can be specified in the application.

2. Creating a circuit simulation program, considering:

- The need to quantize this function.
- Using matrices to set functions.
- Setting the input control matrix in the sine wave form.
- The same matrix sizes when plotting graphs.

3. Change the time and phase charts design to improve readability.

4. The removal of the obtained schedules for the subsequent laboratory work execution in the preparation for the defense.

5. Repeat steps 2-4 for other parameters.

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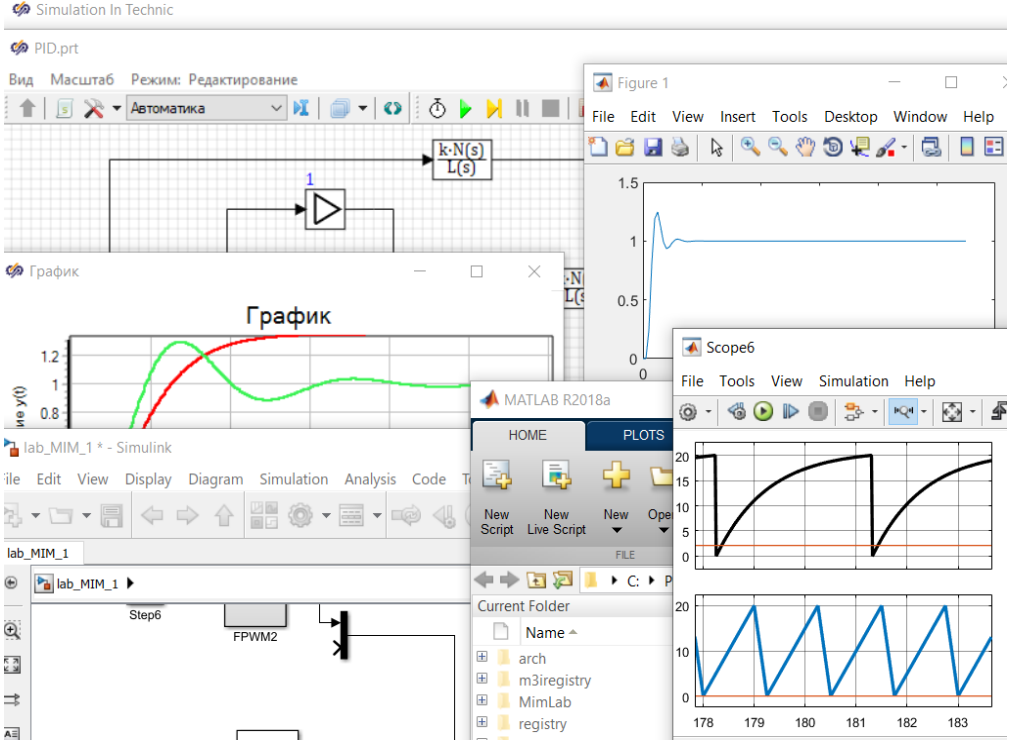
Conclusion

This workshop is intended for students to study simulation techniques. The use of various software products allows you to get a wider understanding of the various methods of modeling automatic systems.

Using such software as MATLAB, Simulink and SimInTech allows you to gain practical skills for modeling systems and other similar software products.



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Thank you for attention!

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