

VISUALISATION TOOLS OF MATLAB IN EDUCATION

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Abstract: Dynamic graphical presentation of any process is much more interesting to students than a verbal description of this process. When are changed the input parameters, the students can see directly the changes in the graphic representation of this process. The advantage of MATLAB is that it allows the use of available tools that can handle almost all students. There are not required the advanced programming techniques. Students will create the environment of this process with aim to observe the changes through changes of input data. They improve not only your experiences with using tools of Matlab, but the information of this process as well.

Key words: Matlab, visualisation, education

1 Introduction

Using of software tools in teaching are today already commonplace. Some software tools can increase interest of students and thus effectively present new knowledge. The correct and appropriate use of the various tools of software products in education can help improve efficiency. They can help [1]:

- create a clearer imagination of presented topic,
- allow us to communicate and to give information in the shortest possible time,
- develop mental and especially cognitive and logic thinking processes and skills necessary for self-education.

The presented contribution will describe the selected tools of software product Matlab for teaching of basic static characteristics of the artificial muscle.

2 Briefly description of artificial muscle

Pneumatic muscles are an unconventional type of pneumatic actuators. Its use is mostly due to its specific features beyond the capabilities of conventional pneumatic actuators. One of the advantages of the pneumatic muscle is their low weight respectively high-performance ratio of their weight, what allows their use in mobile structures and possibly in mobile applications. Other advantages include their low cost, maintenance-free, quiet operation and not least flexibility [2].

From the static characteristics of the pneumatic artificial muscle, it is clear that the muscle develops maximum force at the minimum contractions. This force with increasing value of contraction decreases almost linearly (dependencies are characterized by the certain nonlinearity particular at the lower values of contraction).

For the purpose of describing of visualization tools in MATLAB is there used dependence of muscle contraction on the pressure for a simple geometric model. Size of contraction of the pneumatic artificial muscles depends on the pressure in the muscle and the muscle load. Relationship for this dependence can be derived from the simple geometric model of muscle. In this contribution was used the follow equation.

$$\kappa = 1 - \sqrt{\frac{4F\pi N^2}{3pl_0^2} + \frac{b^2}{3l_0^2}} \quad (1)$$

There will be determined the values of the muscle contraction depending on the pressure according to (1) for the pneumatic artificial muscle with the following parameters: initial muscle length $l_0 = 264$ mm, constant fiber length $b = 277.1$ mm, the number of encircle one fiber around the cylinder $N = 1.5$ for different values of the loading force. In this it is considered a zero thickness of the cylinder wall [3].

3 Tools of Matlab

MATLAB is a high-performance language designed for technical computing. It is a language, whose basic element is a field that the user does not define. This makes it possible to solve technical computing problems [4]. It is a system of tools that consist of several parts:

- program language of Matlab,
- working environment of Matlab – development tools, processing, debugging of information,
- graphical system of Matlab – it includes commands for 2D and 3D data visualization, image processing, animation and commands to build graphical user interface,
- library of mathematical and other functions,
- toolboxies – optional libraries of specialized functions for solution of specific tasks,
- simulink – essential toolbox for the simulation of linear and nonlinear dynamical systems. It enables system modeling using graphical flow charts.

3.1 Used tools

Handle function is Matlab data type that contains an information used for referencing function. This function allows us to transfer mainly the access information about function (objects) other functions.

Uicontrol – is an object of Matlab, which allows us to create active components - the command buttons, sliders, textbox and so on. When set handle, we can change its properties, such as color, position and also call other procedures.

Programming tools - Matlab contains a programming language so we can use it for all of its structure.

GUIDE – is a tool for creating an user interface that is created by using specific tools. The creation of such an environment is very simple. GUI allows users to create the applications without knowledge of commands needed to work with the command line MATLAB [4]. It can be used not only for practical measurement and simulation as well as for teaching. Using GUI students can acquaint themselves in detail with the properties of selected functions and their parameters when changing and watch expressions of these changes. They improve so visually understanding of these functions.

4 Application of selected tools of Matlab

For presentation purposes we can select in Matlab multiple tools. In this contribution will be used basic tools of working environment and the possibility to use extension for creating user interfaces - GUIDE.

4.1 Creation of user environment using M- files

For the purposes of this design we will use commands *figure*, *uicontrol* and their properties and methods. We will use the possibility of parameter's change via style *Slider*. There is used the command *get* to find a list of object properties and to change them is used the

command *set*. If we know the names of individual qualities and values that may take, we can write them directly in the design of the object. Possible design of user environment for the selected dependency presents the following picture.

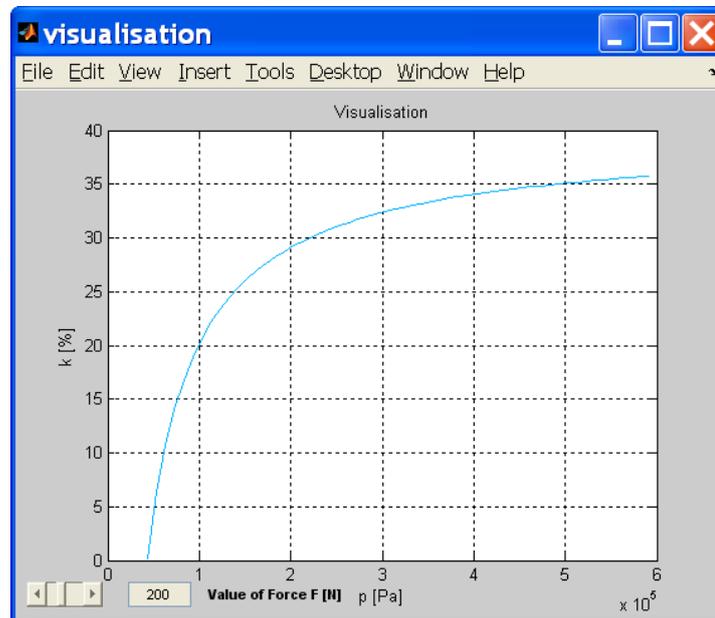


Fig. 1: The user environment with using M-files

The disadvantage of this method is its difficulty at the skills with using the properties of selected objects.

4.2 Use of the cycle

If we want to create the impression of animation, we can use a simple command *pause* in a mode of selected cycle. We can use this command in conjunction with the basic commands to draw 2D graph - *plot*. Possible use of the cycle is shown in the following sequence.

```
for F=100:100:600
    pause(2)
    kon=100*(1-sqrt((4.*F.*pi.*N.^2)./(3.*p.*(l.^2))+ (b.^2)./(3.*l.^2)));
    p1=plot(p,kon,'linewidth',[1.3], 'color',[0 1-(0.3*F)/200 1]);
:
end
```

The value of force F is gradually changing. This change causes the change of contraction value of artificial muscle. The result is presented by Fig.2.

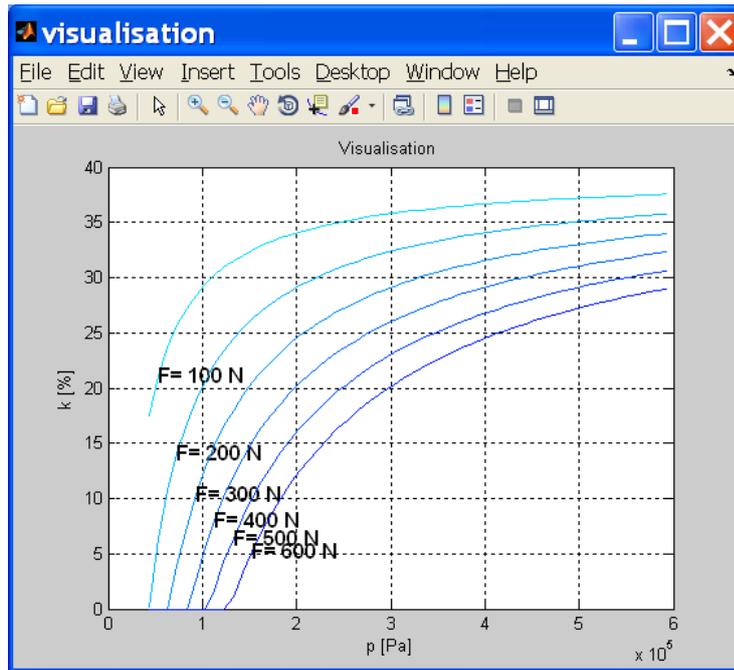


Fig. 2: Results of using *for*

4.3 Creating a setting using GUIDE

To view dependencies of the selected parameters will use the elements of the setting GUIDE. The following figure shows the draft of setting.

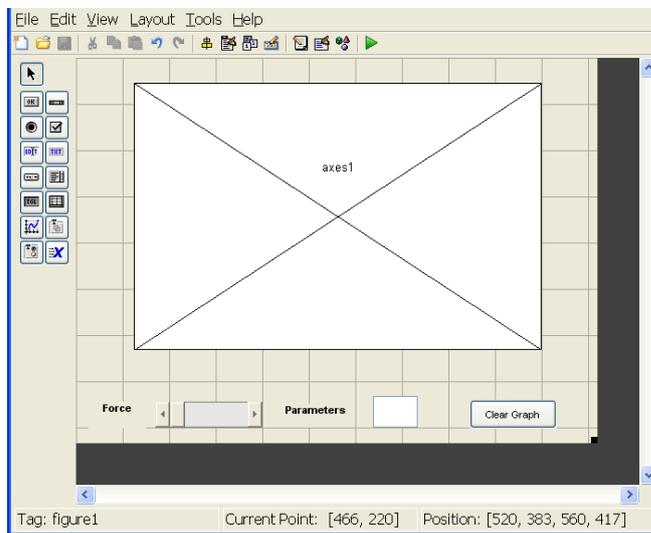


Fig. 3: Design of GUI setting

Active element in this proposal is the *SLIDER* that changes gradually the value of force F . Change of dependence will be viewed immediately in this graph, even with the change of line color and description. Result represents the next picture.

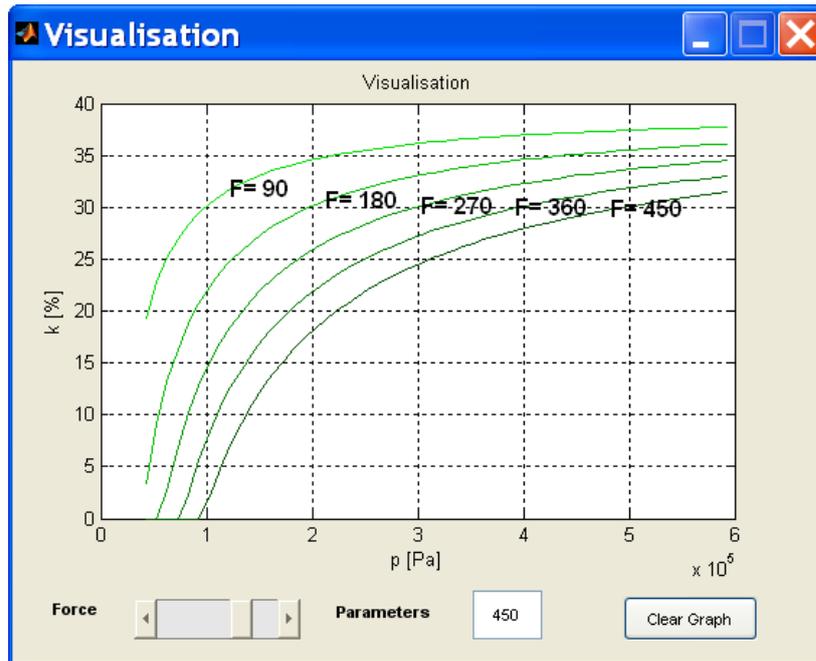


Fig. 4: Results

Conclusion

In the presented paper is described the possible way of use of Matlab tools for teaching in different areas. Its tools allow us to use visualisation and so more clearly interpret the current topic and they can also improve students' skills in working with software tools of Matlab. The basis is to understand creating and possibilities of M-files, which can be used then for the design of the user interface using tools of Guide. In this contributions were changed the value of force F , but it is possible to change other parameters in an analogous manner.

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