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IMPROVED PARAMETRIC IDENTIFICATION FOR THE LINEAR AUTOMATION OBJECTS BASED ON THE DIGITALISED MEASUREMENTS

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***Annotation*:** This research deals with the development of the procedures for the improved parametric identification of the linear automation objects on the basis of the usage of the digitalised data of the measurements. It is shown, that the usage of the digitalised measured data requires the relevant procedures for the parametric identification of the automation object, and such procedures must involve the regularization excluding the computations of the derivatives.

Key words: Digitalised signals, parametric identification, automation object, mathematical modelling, finite differences, regularization, time discretisation interval.

The improved parametric identification is significantly required to provide the energy and resource efficiency of the exploitation of the automation objects on the different operating modes, and only the digitalised measurements can provide it. Due to these circumstances, the development of the improvement procedures for the parametric identification based on the digitalised measured data is relevant with the green end digital transitions, whose are the primary priorities of the development of European Union, as it is highlighted in the political guidelines [1, 2]. So, the theme of this research is relevant due to the agreement with the modern trends related with the ambitions in the green and digital transitions.

The development of the procedures for the parametric identification is permanently relevant due to the continuous improvement of the products, and the research [3] can be as one of examples of this. In the research [4] it is shown, that the improvement of the parametric identification procedures allows to improve the opportunities of the instrumental measurements due to the possibilities of the estimations of the magnitudes, whose cannot be measured directly in principle. In the research [5] it is shown, that the parametric identification allows to make the continuous technical diagnostics of the automation objects. Nevertheless, to use the improved opportunity of the parametric identification, it is necessary to use the related improved mathematical model represented by the higher ordered ordinary differential equations, but the parametric identification of such complicated mathematical models has some difficulties, if the measured signals are represented in the discrete form. Such difficulties are due to the incorrectness of the computations of the derivatives for the data with the even very small disturbances. So, the purposes of this research are in the development of the improved parametric identification of the linear automation objects taking into account the usage of the digitalised measured data.

So, mathematical model of the linear automation object is represented in general by means the higher ordered ordinary differential equation. If the measured signals are presented in the discrete form, then to apply the procedure of the parametric identification, the differential equation representing the mathematical model of the considered automation object must be equivalently transformed to the related discrete form, and the finite differences technique must be used to do it. At the same time, the usage of the finite differences formulas is significantly depended on the order of the considered differential equation. Besides, it is possible to use a lot of different finite differences formulas for discretization of the considered or generate differential equation. Taking into account all these circumstances, it is necessary to research, what kinds of the finite difference formulas are the most suitable for the discretisation of the ordinary differential equation to make the parametric identification procedure, and it is necessary to research the possibility of the uniform way to use the finite differences formulas for discretisation of the ordinary differential equation having the different orders. To do all these, it is necessary to consider the particular examples of the automation objects representing by means the linear ordinary differential equations having the second and higher orders. Because of the low experience of the parametric identification for the automation objects representing by the higher order linear differential equations, it is

necessary to begin researches from the relatively simple example about the automation object represented by means the second order linear differential equation. Such equation allows to research the general principles of the usage of the finite differences for the transforming of the linear ordinary differential equation to the discrete form. Indeed, to complete second derivatives it is possible to use a lot of different finite difference formulas, whose can have the different interactions with the finite difference formulas defining first derivatives also presented in the differential equation of second order. Such consideration allows to find the most suitable finite difference formulas for the equivalent transforming of the differential equation having second and higher orders to the discrete form.

The calculation of the derivatives has the inherent incorrectness so that that even the small disturbances of the input data lead to the theoretically infinite disturbances of the results. Such incorrectness has the significant influences on the results of the parametric identification made on the digitalised data of the measurements. So, it is necessary to research the suitable regularization procedures, and one possible way is in permutation of the items involved in the finite difference formulas used to calculate the different variables to transform the linear differential equation to the discrete form. The different ways to do such permutations are possible, but it is necessary to propose the most suitable way to do it for the linear differential equations having the different orders. It is the difficult complex problem, because of the way of permutation of the items for the regularization is related significantly with the finite difference formulas used for the equivalent transforming of the linear original differential equation to the discrete form related with the digitalised measured data for making the parametric identification of the considered automation object.

CONCLUSIONS. The improvement of the parametric identification procedures for the automation objects requires of the development of the suitable finite difference formulas taking into account the necessity of the uniform applications for the differential equations having the different orders, and taking into accounts the necessity of the regularization through the permutation of the items in the differential equations represented in the discrete form.

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