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Algorithm for identification of differential macromodel

***Abstract**. To provide a detailed description of the algorithm identifying differential macromodelling.*

Keywords: macro model, authentication, algorithm.

Introduction

From experimental research measurements [1] we show discrete functional contingencies follow the equation

(1) $u(t_k),\ y(t_k)\ (k=\overline{1,m})$,

Modeling is accomplished using the system of standard differential equalizations

(2) $\dot{y}_0 = y_1;\ \dot{y}_1 = y_2;\ \dots\ \dot{y}_n = P(y_0,\dots,y_n;u_0,\dots,u_p)$

where t_k is the moment in time at which the value of $u(t_k)$ was experimentally measured in which, $y(t_k)$; m is the value of these experimental measurements; of polynomial degrees or the sum of many short, rational functions.

The designed size y is approximately equal to dynamic variables y_0 ($y_0 \approx y$). The knots of t_k are chosen so as to remove possible contingencies representing the value $y(t)$ from the value $u(t)$ on a segment $t \in [t_1, t_m]$. In practice often the value n, p is used equating to 2-5.

On right side of the equalization (2) the reasoning of polynomial P there are derived from *u* and *y*.

These are easily derived from the known discrete contingencies, namely the values of $u(t_k), y(t_k)$ $(k=\overline{1,m})$ with the help of numerical differentiation

$$\bar{u}^{(j)}(t) = \frac{d^j u(t)}{dt^j};\ j=\overline{0,p};\ t_k \in [t_1, t_m];$$

$$\bar{y}^{(i)}(t) = \frac{d^i y(t)}{dt^i};\ i=\overline{0,n+1};\ t_k \in [t_1, t_m];$$

in the problems the determination of discrete contingencies (1). The derivatives $\bar{u}^{(j)}(t_k), \bar{y}^{(i)}(t_k)$, $j=\overline{0,p}$; $i=\overline{0,n+1}$; $k=\overline{1,m}$ approximately equal experimental sizes. $\bar{u}^{(0)}(t_k) \approx u^{(0)}(t_k);\ \bar{y}^{(0)}(t_k) \approx y^{(0)}(t_k);\ k=\overline{1,m}$. The numerical values of derivatives $\bar{u}^{(j)}(t_k), \bar{y}^{(i)}(t_k)$, $j=\overline{0,p}$; $i=\overline{0,n+1}$ must satisfy the last equalization (2) in all of the problems t_k, $k=\overline{1,m}$. So as to arrive at the result for the model parameters (2). Unknown coefficients of polynomial *of P* must be such, that the variation between the left and right sides on a segment $[t_1, t_m]$ was minimum. Choosing for the measure of this variation a quadratic criteria, the task of the discrete plural $\bar{t}_k$. We derive the task

(3) $\min\limits_{c} \sum\limits_{k=1}^{m} \left[\bar{y}^{(n+1)}(\bar{t}_k) - P\left(\bar{y}^{(0)}(\bar{t}_k),\dots,\bar{y}^{(n)}(\bar{t}_k); \bar{u}^{(0)}(\bar{t}_k),\dots,\bar{u}^{(p)}(\bar{t}_k)\right)\right]^2$

where character *c* denotes the plural of coefficients c_j of polynomial *P*. Solving task (3) consists of minimizing the regular Tikhonov Function [2]. The method of solving task (4) consists in the deriving and deleting of «superfluous» elements from the polynomial of degree from the many variables in [1].

With it easy to get models for different experimental data [3-6]. In particular, on the basis of this algorithm such models are developed. Model of course of currencies; model of dynamics of financial streams (payments in a budget, custom collections, receipts in pension fund); model of dynamics of indicators (volumes of passenger transportations, profits of enterprise); a model of influence of course of currencies is on a gross production. A model of influence of sun activity and reveal forces of M is on seismic activity and infra-sound of earthly surface; model of influence of sun activity and feed on morbidity by tuberculosis; model of influence of morbidity by a flu on morbidity by tuberculosis. Models of radio engineering devices (generators, , detectors); models of objects are with a chaotic dynamics.

REFERENCES

[1] Курганевич А., Матвійчук Я. Регуляризація задачі ідентифікації макромоделей нелінійних динамічних систем методом редукції апроксимаційного базису / А. Курганевич, Я. Матвійчук // Теоретична електротехніка. – 2000. – Вип. 55. – С. 31-36.

[2] Тихонов А.Н., Гончаровский А.В., Степанов В.В., Ягола А.Г. Регуляризирующие алгоритмы и априорная информация. – М.: Наука,1983. – 200 с.

[4] Янків-Вітковська Л.М., Савчук С.Г., Янків-Вітковська Л.М., Паучок В.К. До питання аналізу систематичних похибок координат перманентної GPS-станції SULP // *Вісник геодезії і картографії*, Київ. – №5, 2007. – С. 9-13.

[5] Матвійчук Я.М., Савула М.М., Паучок В.К. Модель впливу харчування та сонячної активності на захворюваність туберкульозом // *Інфекційні хвороби*. № 4, 2010. – с.43-49.

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