Fişa suspiciunii de plagiat / Sheet of plagiarism's suspicion	Indexat la: 0120/05

Opera suspicionată (OS)	Opera autentică (OA)
Suspicious work	Authentic work

OS	COLOŞI, Tiberiu, ABRUDEAN, Mihail, DULF, Eva Henrietta, and UNGUREŞAN, Mihaela Ligia. *Numerical modelling and simulation method for lumped and distributed parameters processes with Taylor series and local iterative linearizarion.* Ref.şt.: FEŞTILĂ, Clement, LAZEA, Gheorghe, VÂNĂTORU, Matei. Cluj-Napoca: Mediamira, 2008.
OA	COLOŞI, T., ABRUDEAN, M., DULF, E.H., and UNGUREŞAN, M.L.. *Numerical modelling and simulation method with Taylor series for lumped and distributed parameters processes.* Ref.şt.: FEŞTILĂ, Clement, LAZEA, Gheorghe. Cluj-Napoca: Mediamira, 2006.

Incidența minimă a suspiciunii / Minimum incidence of suspicion	
p.3:01-p.06:16 (cuprins)	p.03:01 – p.06:19 (cuprins)
p.7:01 – p.11:09	p.7:01 – p.11:11
p.12:01 – p.21:15	p.12:01 – p.21:10
p.17:Fig.1.1	p.17:Fig.1.1
p.22:01 – p.27:20	p.22:01 – p.27:20
p.28:01 – p.29:14	p.28:01 – p.29:14
p.34:01 – p.55:06	p.34:01 – p.55:13
p.56:01 – p.61:12	p.56:01 – p.61:12
p.62:01 – p.77:18	p.62:01 – p.77:12
p.78:01 – p.97:15	p.78:01 – p.98:12
p.98:01 – p.131:13	p.98:01 – p.131:10
Fişa întocmită pentru includerea suspiciunii în Indexul Operelor Plagiate în România de la www.plagiate.ro	

Notă: La pag.10 a ambelor cărți există mențiunea că întreaga lucrare a fost elaborată de autorul Coloşi Tiberiu.

TIBERIU COLOȘI
MIHAIL IOAN ABRUDEAN   EVA-HENRIETTA DULF
MIHAELA-LIGIA UNGUREȘAN

NUMERICAL MODELLING AND SIMULATION METHOD with TAYLOR SERIES

for Lumped and Distributed Parameters Processes

MEDIAMIRA
2006

EDITURA **MEDIAMIRA**
str. Horea nr. 47-49/1
400275 Cluj-Napoca
C.P. 117, O.P. 1

COLECŢIA INGINERULUI

T. Coloşi, M. I. Abrudean, E.-H. Dulf, M.-L. Ungureşan

Numerical Modelling and Simulation Method with Taylor Series for Lumped and Distributed Parameters Processes

Referenţi ştiinţifici: Prof. dr. ing. **Clement Feştilă**
Prof. dr. ing. **Gheorghe Lazea**

Descrierea CIP a Bibliotecii Naţionale a României
Numerical modelling and simulation method with Taylor series for lumped and distributed parameters processes /
Tiberiu Coloşi, Mihail Ioan Abrudean, Eva-Henrietta Dulf, Mihaela-Ligia Ungureşan. - Cluj-Napoca: Mediamira, 2006
168 p.; 17x24 cm.
Bibliogr.
ISBN (10) 973-713-108-8; ISBN (13) 978-973-713-108-9

I. Coloşi, Tiberiu
II. Abrudean, Mihail
III. Dulf, Eva
IV. Ungureşan, Mihaela-Ligia

517(075.8)

Chapter 8: "Modelling-simulation examples of for processes with distributed parameters", presents a number of 18 programs, for pde I.2, pde I.3, pde I.4, pde II.2, pde II.3, pde II.4, pde III.2, pde III.3, pde IV.2, pde IV.3 and pde IV.4. All these (pde) have been considered with constant coefficients.

Further more we illustrate a non linear pde II.2 for modelling a column of isotopic separation N^{15}, then two control systems of some processes defined by pde II.2 and pde II.3, and finally a systems made of two (pde), each one of the second order. The chapter ends with two examples containing a ode II, as well as a pde II.2, solved with the methods Taylor series and the Taylor series-L.I.L., underlining some comparative aspects that practically certify the same results.

It needs to be noted that all (ode) and (pde) have proved either general solutions, or particular solutions, and the singular solutions have not been taken into consideration. The particular solutions have been considered in exponential or polynomial variants, used in technique. With these solutions we were able to establish the initial conditions, the final conditions and the possible boundary conditions. Also we were able to establish the performances of numerical integration, using the indicator called "cumulative relative error in percent" (crep), which in most examples was between the limits $(10^{-6} \div 10^{-2})\%$, a fact that certifies the accuracy of the method and the programs.

The entire paper has been elaborated by Tiberiu Coloşi. This paper could not be published without the qualified and collegiate support of all authors.

Some examples and programs have been elaborated and included in year the projects and diploma papers of the students of the Faculty of Automation and Computer Science within the Technical University of Cluj-Napoca.

Prof. Tiberiu Coloşi expresses his thanks and gratitude to Alexander von Humboldt Foundation in Bonn-Germany, for the given material support as well as to Prof.Eng. Rolf Unbehauen, PhD from the Institut für Allgemeine und Theoretische Elektrotechnik der Universitat Erlangen-Nürnberg-Germany for the professional support and the collegiate atmosphere he enjoyed in this university collective, during twenty months.

The authors

II[nd] PART

PROCESSES WITH DISTRIBUTED PARAMETERS

Chapter 4

LINEAR PROCESSES WITH DISTRIBUTED PARAMETERS

4.1. Introduction

It is known that the usual analytical modelling of linear processes with distributed parameters can be expresses using equations or equation systems with linear partial derivatives, homogeneous (without a free component) or non homogeneous (with free component). The category of equations with linear partial derivatives (pde), to which this chapter refers to, is presented in the following examples:

$$a_{00}y + a_{10}\frac{\partial y}{\partial t} + a_{01}\frac{\partial y}{\partial p} = \varphi(t,p) \qquad (4.1)$$

$$a_{000}y + a_{100}\frac{\partial y}{\partial t} + a_{010}\frac{\partial y}{\partial p} + a_{001}\frac{\partial y}{\partial q} = \varphi(t,p,q) \qquad (4.2)$$

$$a_{00}y + a_{10} + \frac{\partial y}{\partial t} + a_{01}\frac{\partial y}{\partial p} + a_{20}\frac{\partial^2 y}{\partial t^2} + a_{11}\frac{\partial^2 y}{\partial t \partial p} + a_{02}\frac{\partial^2 y}{\partial p^2} = \varphi(t,p) \qquad (4.3)$$

$$a_{000}y + a_{200}\frac{\partial^2 y}{\partial t^2} + a_{020}\frac{\partial^2 y}{\partial p^2} + a_{002}\frac{\partial^2 y}{\partial q^2} = \varphi(t,p,q) \qquad (4.4)$$

$$a_{00}y + a_{30} + a_{03}\frac{\partial^3 y}{\partial t^3} + a_{03}\frac{\partial^3 y}{\partial p^3} = \varphi(t,p) \qquad (4.5)$$

$$a_{000}y + a_{300}\frac{\partial^3 y}{\partial t^3} + a_{030}\frac{\partial^3 y}{\partial p^3} + a_{003}\frac{\partial^3 y}{\partial q^3} = \varphi(t,p,q) \qquad (4.6)$$

$$a_{00}y + a_{40} + \frac{\partial^4 y}{\partial t^4} + a_{04}\frac{\partial^4 y}{\partial p^4} = \varphi(t,p). \tag{4.7}$$

$$a_{000}y + a_{400}\frac{\partial^4 y}{\partial t^4} + a_{040}\frac{\partial^4 y}{\partial p^4} + a_{004}\frac{\partial^4 y}{\partial q^4} = \varphi(t,p,q) \tag{4.8}$$

All coefficients (a…) are considered to be constant, and φ(t, p), y(t, p), φ(t, p, q) and y(t, p, q) fulfil the continuity conditions in the Cauchy sense. The independent variables (t), (p), and (q) could represent the time (t), respectively the spatial abscise (p), and (q) defined, for instance, in cartesian coordinates.

The initial conditions (IC) are considered to be known, and other explanations could be added, from case to case, for boundary conditions (BC) and final conditions (FC).

4.2. State variables, initial conditions, boundary conditions and final conditions

Introducing the notations:

$$x_{TP} = \frac{\partial^{T+P} y}{\partial t^T \partial p^P} \tag{4.9}$$

and

$$x_{TPQ} = \frac{\partial^{T+P+Q} y}{\partial t^T \partial p^P \partial q^Q} \tag{4.10}$$

(for T = 0, 1, 2, …P = 0, 1, 2, … and Q = 0, 1, 2, …) the eight pde, that is (4.1), (4.2), …, (4.8) can be rewritten as:

$$a_{00}x_{00} + a_{10}x_{10} + a_{01}x_{01} = \varphi_{00} \tag{4.11}$$

$$a_{000}x_{000} + a_{100}x_{100} + a_{010}x_{010} + a_{001}x_{001} = \varphi_{000} \tag{4.12}$$

$$a_{00}x_{00} + a_{10}x_{10} + a_{01}x_{01} + a_{20}x_{20} + a_{11}x_{11} + a_{02}x_{02} = \varphi_{00} \tag{4.13}$$

$$a_{000}x_{000} + a_{200}x_{200} + a_{020}x_{020} + a_{002}x_{002} = \varphi_{000} \tag{4.14}$$

$$a_{00}x_{00} + a_{30}x_{30} + a_{03}x_{03} = \varphi_{00} \quad (4.15)$$

$$a_{000}x_{000} + a_{300}x_{300} + a_{030}x_{030} + a_{003}x_{003} = \varphi_{000} \quad (4.16)$$

$$a_{00}x_{00} + a_{40}x_{40} + a_{04}x_{04} = \varphi_{00} \quad (4.17)$$

$$a_{000}x_{000} + a_{400}x_{400} + a_{040}x_{040} + a_{004}x_{004} = \varphi_{000} \quad (4.18)$$

In the hypothesis of integration with respect to the time (t), the elements of the state vector (**x**), which correspond to the pde (1), (2), ...(8) are presented in Table 4.1.

Table 4.1

edp	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)	(4.7)	(4.8)
Notation	I·2	I·3	II·2	II·3	III·2	III·3	IV·2	IV·3
x	x_{00}	x_{000}	x_{00} x_{10}	x_{000} x_{100}	x_{00} x_{10} x_{20}	x_{000} x_{100} x_{200}	x_{00} x_{10} x_{20} x_{30}	x_{000} x_{100} x_{200} x_{300}

The notation (n · υ) in line 2, Table 4.1, underline by n = I, II, III and IV the order of pde, and by υ = 2 and 3 the number of variables, respectively 2 for (t, p) and 3 for (t, p, q).

The state vector is presented in Table 4.2 for the initial conditions ($\mathbf{x}_{IC}$) and for some possible boundary conditions ($\mathbf{x}_{BC}$), respectively the final conditions ($\mathbf{x}_{FC}$), where (0) and (f) underline the initial and final values.