SYSEG – Symbolic State Equation Generation

Mihai Iordache
University Politehnica of Bucharest Romania
mihai.iordache@upb.ro
Sorin Deleanu
Northern Alberta Institute of Technology, Edmonton,
Canada, sorind@nait.ca
Ciprian Curteanu, Neculai Galan, Atanasie Moscu
University Politehnica of Bucharest Romania,
cipriancurteanu@yahoo.com,galan.nicolae@yahoo.com, atta.tour@gmail.com

Abstract— **The main objective of this paper is to present an efficient method for the systematic formulation of the state equations characterizing linear and/or nonlinear, time-invariant analog circuits with elements in excess. The state equations are represented in symbolic, numeric-symbolic and/or numeric normal-form. First, we have developed an algorithm, then a software package called SYSEG (SYSEG – Symbolic State Equation Generation), capable to formulate the equations in the normal form. SYSEG allows the formulation of state equations in a compact form, through successive cancellations and simplifications of the expressions, without the necessity to calculate any inverse matrices. Degeneracies of the first kind are unitarily treated, in order to allow a symbolic representation of the circuit with a minimum number of state variables. The circuits subjected to SYSEG capabilities may contain linear and nonlinear resistors, inductors, and capacitors, independent voltage and current sources, and all four types of linear controlled sources. Furthermore, we proved that SYSEG is a very useful tool for symbolic analysis and design of linear and/or nonlinear time-invariant analog circuits, providing illustrative examples.**

Keywords— **symbolic analysis, excess elements, state equations,eigenvalues, transfer functions, poles and zeros**

REFERENCES

[1] M. Iordache, Lucia Dumitriu, Computer-Aided Simulation of Analoque Circuits – Algorithms and Computational Techniques, POLITEHNICA Press Publishing House, Vol. I and Vol. II, Bucharest 2014. (in Romanian)

[2] M. Iordache, Lucia Dumitriu, The Modern Theory of Electric Circuits vol. II, ALL Educational Press, Bucharest, 2000. (in Romanian)

[3] M. Badea, Computer-Aided Analysis of Electrical Circuits, Infomed Craiova Press, 2000. (in Romanian)

[4] M. Iordache, Lucia Dumitriu, „Nonlinear Source Method for Large- Scale Circuit Analysis", The International Conference on Applied and Theoretical Electricity ICATE 2000, Craiova, Romania, pp. 37-43.

[5] P. Cristea, Analysis of Nonlinear Circuits Nonliniare, POLITEHNICA Press Publishing House, Bucharest, 1979. (in Romanian)

[6] M. Iordache, Lucia Dumitriu, Computer-Aided Simulation of Analoque Circuits – Algorithms and Computational Techniques, (in Romanian), POLITEHNICA Press Publishing House, Vol. I and Vol. II, Bucharest 2014. (in Romanian)

[7] M. Preda, P. Cristea, Electrical engineering fundaments, Vol. II, E.D.P. Press, Bucharest, 1980. (in Romanian)

[8] C.I. Mocanu, Electrical circuits theory, E.D.P. Press, Bucharest, 1979, in Romanian.

[9] P. Young, Parameter estimation for continuous-time models - a survey", Automatica, VOL. 17, No. 01, pp. 23-39, 1981.

[10] Y. Uwate, Y. Nishio and R. Stoop, "Complex pattern in a ring of van der Pol oscillators coupled by time-varying resistors", Journal of Circuits, Systems and Computers, 19 (4) (2010), pp. 819–834.

[11] M. Iordache, Lucia Dumitriu, D. Delion, "Automatic Formulation of Symbolic State Equations for Analog Circuits with Degeneracies", Proceedings of 6th International Workshop on Symbolic Methods and Applications in Circuit Design, SMACD 2000, October 12-13, 2000, pp. 65-72.

[12] L. O. Chua, and P. M. Lin, Computer-Aided Analysis of Electronic Circuits, Englewood Cliffs, N. J.: Prentice Hall, Inc., 1975

[13] A. E. Schwarz, Computer-Aided Design of Microelectronic Circuits and Systems. London: Academic Press, 1987.

[14] K. Singhal and J. Vlach, "Symbolic analysis of analog and digital circuits", IEEE Transactions on Circuits and Systems, vol. CAS-24, no. 11, November 1977,, pp. 598-609.

[15] M. Iordache, Lucia Dumitriu, D. Delion, SYSEG – **SY**mbolic **S**tate **E**quation **G**eneration program, User Guide, Library of Electrical Deparment, Politehnica University of Bucharest, 2010.

[16] M. Iordache, Lucian Mandache, Computer-aided analysis of analogic nonlinear circuits, Politehnica Press, Bucharest, 2004.