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# Nonsmooth Modeling and Simulation for Switched Circuits

Springer

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# Preface

The major aim of this monograph is to show that the nonsmooth dynamics framework (involving keywords like complementarity problems, piecewise-linear characteristics, inclusions into normal cones, variational inequalities, multivalued characteristics) is a convenient and efficient way to handle *analog* switched circuits. It has been long known in the circuits community that such nonsmooth switched systems are difficult to simulate numerically, for various reasons that will be recalled. In parallel the simulation of nonsmooth mechanical systems (*i.e.* mainly mechanical systems with nonsmooth interface or contact laws, like unilateral constraints, impacts, Coulomb's friction and its many extensions, *etc.*) has been the object of a lot of research studies (see for instance the recent monographs Acary and Brogliato 2008 and Studer 2009). This field has now reached a certain degree of maturity, and has proved to be a quite useful and efficient approach in many areas of mechanics. Here we would like to show that the tools that have been employed in the contact mechanics context, can be successfully extended to the simulation of analog switched circuits. To the best of our knowledge it is the first time that such extensive numerical simulations using the nonsmooth dynamics framework for analog switched circuits are presented and published.

Montbonnot

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# List of Abbreviations

| | |
|---|---|
| ACEF | Automatic Circuit Equations Formulation |
| API | Application Programming Interface |
| BCE | Branch Constitutive Equation |
| BDF | Backward Differentiation Formulas |
| CCP | Cone Complementarity Problem |
| DAE | Differential Algebraic Equation |
| KCL | Kirchhoff's Current Laws |
| KVL | Kirchhoff's Voltage Laws |
| LCP | Linear Complementarity Problem |
| LTI | Linear Time Invariant |
| MCP | Mixed Complementarity Problem |
| MDE | Measure Differential Equation |
| MDI | Measure Differential Inclusion |
| MLCP | Mixed Linear Complementarity Problem |
| MNA | Modified Nodal Analysis |
| NCP | Nonlinear Complementarity Problem |
| NSDS | NonSmooth Dynamical Systems |
| ODE | Ordinary Differential Equation |
| OSNSP | Onestep NonSmooth Problem |
| STA | Sparse Tableau Analysis |

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