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Nonsmooth Modeling and Simulation for Switched Circuits

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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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