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► **To cite this version:**

Bertrand Cottenceau, Mehdi Lhommeau, Laurent Hardouin, Jean-Louis Boimond. Data processing tool for calculation in dioid. WODES'2000, Workshop on Discrete Event Systems, Aug 2000, Ghent, Belgium. pp.x-x. hal-00845037

HAL Id: hal-00845037

<https://hal.science/hal-00845037>

Submitted on 16 Jul 2013

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DATA PROCESSING TOOL FOR CALCULATION IN DIOID

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Keywords: Dioid, Timed Event Graph, Periodic Series

Abstract This note presents briefly a data processing tool to handle the periodic series.

Introduction

The team (max, +) of the INRIA Rocquencourt has developed a toolbox, integrated in software Scilab, for calculation in the dioids (max, +) or (min, +). We propose here to present a library of calculation for the periodic series in the dioid of formal series.

1. DATA PROCESSING TOOL

Let us recall that a timed event graph (TEG) is a timed Petri net whose each place has only one upstream transition and one downstream transition. The behavior of these graphs can be described by using one linear equations system into some particular dioids, for instance in the dioid of formal series such like the dioid $\mathcal{M}_{in}^{ax}[[\gamma, \delta]]$ (see [1]). The input/output behavior of TEG can then be described by a state representation ($X = AX \oplus BU$, $Y = CX$) and/or a transfer matrix $H = CA^*B$ with $A^* = \bigoplus_{i \in \mathbb{N}} A^i$.

Each entries of this matrix is a periodic and causal series admitting a representation of the form: $s = p \oplus qr^*$ with $p = \bigoplus_{i=0}^{\alpha} \gamma^{n_i} \delta^{t_i}$, $q = \bigoplus_{j=0}^{\beta} \gamma^{N_j} \delta^{T_j}$ and $r = \gamma^{\nu} \delta^{\tau}$. The series is said proper if $(n_{\alpha}, t_{\alpha}) \leq (N_0, T_0)$ and if $(N_{\beta} - N_0, T_{\beta} - T_0) \leq (\nu, \tau)$. A series admits a simplest periodic proper representation, called the canonical form of s .

As an example, below we provide a TEG, its representation of state and its transfer matrix in dioid $\mathcal{M}_{in}^{ax}[\gamma, \delta]$.

$$\begin{cases} X &= \begin{pmatrix} \varepsilon & \delta & \varepsilon \\ \gamma & \varepsilon & \varepsilon \\ \gamma^2\delta^2 & e & \varepsilon \end{pmatrix} X \oplus \begin{pmatrix} \gamma\delta & \varepsilon \\ \varepsilon & e \\ \varepsilon & \varepsilon \end{pmatrix} U \\ Y &= (\varepsilon \ \varepsilon \ e) X \\ Y &= (\gamma^2\delta \oplus \gamma^3\delta^3(\gamma\delta)^* \quad e \oplus \gamma\delta \oplus \gamma^2\delta^3(\gamma\delta)^*) U = HU. \end{cases}$$

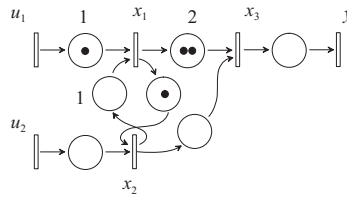


Figure 1 GET example

In this context, the manipulation of elementary systems and the synthesis of correctors require data-processing tools in order to handle the periodic series. S. Gaubert [4] proposes a certain number of algorithms making it possible to calculate the *sum*, the *product* and the *star* of these series. In [2] we propose algorithms computing the *inf* and the *residuation* of these same series. There are two implementations of these algorithms, one developed in script Matlab and the other developed with language C++. We also propose a module making possible to interface this latest library with Scilab. This software was used to calculate, for instance, the applications of the references [3]. All these tools are available on <http://www.istia.univ-angers.fr/~hardouin>.

References

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