DATA PROCESSING TOOL FOR
CALCULATION IN DIOID

Cottenceau Bertrand, Lhommeau Mehdi, Hardouin Laurent, Boimond Jean-Louis
LISA
62, Avenue Notre-Dame du Lac, 49000 ANGERS, FRANCE
hardouin@istia.univ-angers.fr

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 tool-
box, 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 $\mathcal{N}_{\text{in}}^{\mathbb{Z}}[[\gamma, \delta]]$ (see [1]). The input/output behavior of TEG can then be described by a state represen-
tation $(X = AX \oplus BU, Y = CX)$ and/or a transfer matrix $H = CA^tB$
with $A^t = \bigoplus_{i \in \mathbb{N}} A^i$.

Each entries of this matrix is a periodic and causal series admit-
ting a representation of the form: $s = p \oplus qr^s$ with $p = \bigoplus_{i=0}^{\mathbb{N}} \gamma_i \delta^i$, $q = \bigoplus_{j=0}^{\mathbb{N}} \gamma_j \delta^j$ 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 doid $M_{\text{Max}}[[\gamma, \delta]]$.

\[
\begin{align*}
X &= \begin{pmatrix} 
\varepsilon & \delta & \varepsilon \\
\gamma & \varepsilon & \varepsilon \\
\gamma^2\delta^2 & \varepsilon & \varepsilon 
\end{pmatrix} X \oplus \begin{pmatrix} 
\varepsilon & \varepsilon \\
\varepsilon & \varepsilon \\
\varepsilon & \varepsilon 
\end{pmatrix} U \\
Y &= \begin{pmatrix} 
\varepsilon & \varepsilon & \varepsilon 
\end{pmatrix} X \\
Y &= (\gamma^2\delta \oplus \gamma^3\delta^3(\gamma\delta)^* \varepsilon \oplus \gamma\delta \oplus \gamma^2\delta^3(\gamma\delta)^*) U = HU.
\end{align*}
\]

![GET example](image)

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


