COINC Library : A toolbox for Network Calculus.

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This talk will present the Scilab toolbox for Network Calculus computation. It was developed thanks to the INRIA ARC COINC project (COmputational Issue in Network Calculus see `http://perso.bretagne.ens-cachan.fr/~bouillar/coinc/spip.php?rubrique1`). This software library deals with the computation of ultimately pseudo-periodic functions. They are very useful to compute performance evaluation in network (e.g. Network Calculus) or in embedded system (Real Time Calculus).

Each function f is composed of segments characterized by (x, y, y^+, ρ, x_n) (see figure 1), arranged in two lists of segments denoted p and q and with a segment denoted r, it is denoted : $f = p \oplus qr^*$. List p is composed of segments which depict a transient behavior, list q is composed of segments which represent a pattern repeated periodically, segment r is a point representing the periodicity of function f (see figure 1). The formulation is inspired by the one of periodical series in the idempotent semiring of formal series such as introduced in [1], and which have their own Scilab toolbox called Minmaxgd [5] based on algorithms proposed in [6] and in [4], [7]. The COINC toolbox yields six operations handling ultimately pseudo periodic function (uppf), namely

– The minmium of two uppf (the sum in the $(min, +)$ setting) :

$$p \oplus qr^* = (p_1 \oplus q_1 r_1^*) \oplus (p_2 \oplus q_2 r_2^*)$$

– The (min-+) convolution of two uppf (product of two uppf) :

$$p \oplus qr^* = (p_1 \oplus q_1 r_1^*) \otimes (p_2 \oplus q_2 r_2^*)$$

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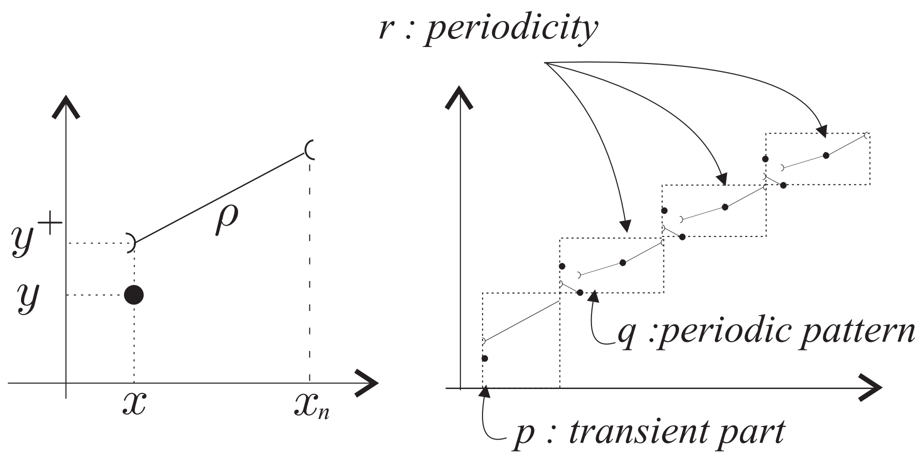

FIGURE 1 – A monomial (a point (x, y) and a segment starting in (x, y^+) with a slope equal to ρ and ending in x_n) and an uppf function ($f = p \oplus qr^*$).

- The (min,+) deconvolution of two uppf (residuation of two uppf) :

$$p \oplus qr^* = (p_1 \oplus q_1 r_1^*) \oslash (p_2 \oplus q_2 r_2^*)$$

- The addition of two uppf (The Hadamard product of two uppf) :

$$p \oplus qr^* = (p_1 \oplus q_1 r_1^*) \odot (p_2 \oplus q_2 r_2^*)$$

- The sub-additive cloture (The Kleene star of an uppf) :

$$p \oplus qr^* = ((p_1 \oplus q_1 r_1^*))^*$$

The software is based on algorithms given in [2], and also in [6], [4] and [7], it is available as a Scilab contribution and on the following url `http:\\www.istia.univ-angers.fr\~lagrange\COINC`.

During the talk some illustrations about Network Calculus (see [8],[3]) will be proposed including all those operations. Let just recall that an arrival curve is a segment $(0, \sigma, \sigma, \rho, +\infty)$ with σ the burst and ρ the arrival rate, and a service curve is represented by a list of two segments $m_1 \oplus m_2$ with $m_1 = (0, 0, 0, 0, \tau)$ and $m_2 = (\tau, 0, 0, \theta, +\infty)$ with τ the delay and θ the service rate.

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