#SleptsovNets (#СетиСлепцова)– a path to USA Encyclopedia of Information Science and Technology

A chapter on *Sleptsov net computing* is to appear in July 2017 in Encyclopedia of Information Science and Technology, Fourth Edition, IGI-Global, USA

http://www.igi-global.com/book/encyclopedia-information-science-technology-fourth/173015

Timed Petri nets with multichannel transitions (multiple firing strategy) have been introduced in

Zaitsev D.A. Solving operative management tasks of a discrete manufacture via Petri net models. PhD thesis. (http://daze.ho.ua/daze-phd-1991.pdf). Kiev, the Academy of sciences of Ukraine, Institute of Cybernetics name of V.M.Glushkov, 1991. In Russ.

Then we published a paper

Zaitsev D.A., Sleptsov A.I. State equations and equivalent transformations for timed Petri nets, Cybernetics and Systems Analysis, Volume 33, Number 5 (1997), 659-672, http://dx.doi.org/10.1007/BF02667189

and further developed the concept in

Zaitsev D.A. Invariants of Timed Petri Nets, Cybernetics and Systems Analysis, Volume 40, Number 2 (2004), 226-237, http://dx.doi.org/10.1023/B:CASA.0000034448.97077.dd

Recently at MCU conference in Zurich, 2013, I've got known that many researchers use the concept in spiking P neuron systems and DNA computing calling it "exhaustive use of rule" without references to our papers.

Thus I decided to call the nets *Sleptsov nets* in honor of my PhD supervisor Anatoly Sleptsov who hinted me the idea. I presented them first at TMPA-2013

https://www.slideshare.net/IosifItkin/tmpa2013-dmitry-zaitsev

An international approval had been acknowledged by the paper

Zaitsev D.A. Sleptsov Nets Run Fast, IEEE Transactions on Systems, Man, and Cybernetics: Systems, 2016, Vol. 46, No. 5, 682 – 693, epub: 01 July 2015, http://dx.doi.org/10.1109/TSMC.2015.2444414

A new concept name is justified by the fact that Sleptsov nets run exponentially faster regarding Petri nets; that allows using them as a graphical language of concurrent programming. The ideas have been developed in the paper

Zaitsev D.A., Jurjens J. Programming in the Sleptsov net language for systems control, Advances in Mechanical Engineering, 2016, Vol. 8(4), 1-11. http://dx.doi.org/10.1177/1687814016640159

and presented at the keynote talk

http://icacci-conference.org/setcac2016/keynote.html

The concept of a universal Sleptsov net

Zaitsev D.A. Universal Sleptsov Net, International Journal of Computer Mathematics. Online 20 Jan 2017,
http://dx.doi.org/10.1080/00207160.2017.1283410

as a prototype of massively parallel fast processor had been refined during a dedicated lecture in TUM, Munich, 2017

https://www7.in.tum.de/~schulzef/2017-01-27-Dmitry-Zaitsev.pdf

and finally invited as a keynote talk to a conference held in Polish Academy of Science

https://www.eurosis.org/cms/?q=node/3492

Announce of the talk contains a brief abstract on Sleptsov nets:

A universal Petri net (UPN) represents a processor in the Petri net paradigm of computing. A UPN executes (runs) a program specified by a Petri net (PN) which initial marking represents input data and final marking represents output data.

A crucial obstacle for application of Petri nets as a general-purpose language for concurrent programming consists in the fact they run exponentially slower comparing Turing machines. A class of place/transition nets with multiple firing of a transition at a step has been called Sleptsov nets. Sleptsov nets run fast compared to Petri nets that opens prospects for their practical application and composition of efficient universal Sleptsov nets (USNs).

A series of UPNs/USNs have been constructed in an explicit form via: a) direct specification of the state equation of an inhibitor PN; b) simulation of small universal Turing machines by a deterministic inhibitor PN; c) simulation of an elementary cellular automata Rule 110 by infinite (conventional) PNs; d) direct specification of Markov normal algorithm rules by an inhibitor PN; e) simulation of small universal Turing machines by a deterministic inhibitor Sleptsov net. An encoded PN/SN is loaded into dedicated places of a UPN/USN. Small universal Turing machines and universal cellular automata employ sophisticated chains of encodings (simulations). Obtained small universal nets contain less than half a hundred nodes.

When constructing universal nets, a library of subnets has been completed for computing basic arithmetic, logic, and copying operations. A technique for specification of a given algorithm by a PN (SN) program has been developed to combine data with control flows, implement basic operators of branching, loop, parallel execution, and subroutine (subnet) call-return. To combine data with control flows, special dashed and dotted arcs have been introduced as abbreviations for composition of copying subnets.

An advantage of the approach is its conceptual unity. Only PNs/SNs are applied for programming and running programs. High-level nets, using modular principle of composition (subnets), are compiled into a plain low-level inhibitor/priority net which is considered as an analog to assembler language. Then a UPN/USN runs the obtained net.

Examples of RSA encryption/decryption, solving Laplace equation, computing a fuzzy logic function, and fast discrete-time linear control accomplish the presentation of universal nets and illustrate principles of programming in Petri/Sleptsov nets.

Comments on a recent piece of CACM news

https://cacm.acm.org/news/208078-selfie-with-a-view-on-cybernetics-and-systems-analysis/fulltext

express impartial opinions on the subject.

Sincerely,
Dmitry Zaitsev
http://member.acm.org/~daze