

Artiom, Rudi, and Sergiu at BWMC 2019

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Overview

Anti-Matter and Anti-Membranes

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The Idea of Anti-Matter



For any object a (*matter*), we consider its anti-object (*anti-matter*) a^- and the corresponding *annihilation rule* $aa^- \rightarrow \lambda$.

This rule is assumed to exist in all membranes.

These annihilation rules may have (weak) priority over all other rules.


-  Artiom Alhazov, Bogdan Aman, Rudolf Freund: *P Systems with Anti-Matter*. In: Marian Gheorghe, Grzegorz Rozenberg, Arto Salomaa, Petr Sosík, Claudio Zandron (eds.), *Membrane Computing - 15th International Conference, CMC 2014, Prague, Czech Republic, August 20-22, 2014, Revised Selected Papers, LNCS 8961*, Springer, 66–85, 2014.

The Concept of Anti-Matter

-  A. Alhazov, B. Aman, R. Freund, Gh. Păun: *Matter and Anti-Matter in Membrane Systems*. Descriptive Complexity of Formal Systems - 16th International Workshop, DCFS 2014, Turku, Finland, August 5-8, 2014. Proceedings, 65–76, (2014).
-  Artiom Alhazov, Rudolf Freund, Petr Sosík: *Small P Systems with Catalysts or Anti-Matter Simulating Generalized Register Machines and Generalized Counter Automata*. The Computer Science Journal of Moldova **23** 3, 304–328, 2015.

Anti-Matter as a Frontier of Tractability

Adding the concept of anti-matter may increase the power of a kind of P system even with respect to complexity.

 Daniel Díaz-Pernil, Francisco Peña-Cantillana, Artiom Alhazov, Rudolf Freund, Miguel A. Gutiérrez-Naranjo: *Antimatter as a Frontier of Tractability in Membrane Computing*. *Fundam. Inform.* **134**, 1–2, 83–96, 2014.

Despite the enormous number of variants considered by the Sevillan team, this seems to be the only paper including anti-matter.

Anti-Membranes

Instead of considering a (*matter*) and its anti-object a^- and the corresponding *annihilation rule* $aa^- \rightarrow \lambda$ we now consider the anti-membrane $[]_{\bar{h}}$ for each membrane $[]_h$.

Then there are several semantics for the *annihilation rule* $[]_h []_{\bar{h}} \rightarrow \lambda$.

For example, only the surrounding membranes may be eliminated by the annihilation rule. On the other hand, both membranes with their whole contents may be eliminated.

Spiking Neural P Systems with Astrocytes

Consider spiking neural P systems where the axons leaving a neuron are affected by a second kind of cells, the *astrocytes*.

The astrocytes may have excitatory or inhibitory effect on the axon(s) they work on. They themselves may be affected by the underlying net of neurons, i.e., we may consider a spiking neural P system with astrocytes as a system with two *interleaving networks*.

Register Machines over Finitely Generated Groups

Consider a finitely generated group G with generators $\{e_i \mid 1 \leq i \leq n\}$.

A *register machine over G* then increments a register by adding an e_i and decrements by adding $-e_i$.

We may check for zero in any such group, but checking for a register still to be *non-negative* requires a total order on G .

Rule Forms in (Tissue) P Systems

Given a specific kind of (tissue) P system we may ask if for every system of that given type there exists an equivalent system of that type which fulfills the requirement that all rules are of restricted forms.

A challenging question in this context is how to construct the equivalent system directly from the given one.

Tissue P Systems with Reverse Activation and Blocking



Artiom Alhazov, Rudolf Freund, Sergiu Ivanov:
P Systems with Activation and Blocking of Rules. In:
Susan Stepney and Sergey Verlan (eds.): Unconventional
Computation and Natural Computation - 17th
International Conference, UCNC 2018, Fontainebleau,
France, June 25-29, 2018, Proceedings, LNCS 10867,
Springer, 1–15, 2018.

Instead of activating and blocking rules in the future (forward activating and blocking), we think of a model where the rules applied in a derivation step are justified from the future (reverse activating and blocking): **future determines the present.**

Tissue P Systems with Reverse Activation and Blocking and Forward Activation and Blocking

In the model with the semantics of forward activating and blocking, we then also allowed backward activating and blocking, thus obtaining a way to **go beyond Turing**.

We now have to investigate the effect of forward activating and blocking in the model with the semantics of reverse activating and blocking and to see in which way we might **go beyond Turing** again.

Tissue P Systems with (Reverse) Activation and Blocking and Annihilation of Rules

In both variants of activating and blocking of rules we can also consider multisets of activations and blockings of rules resulting in multisets of rules available to be applied in a derivation step, i.e., the number of blockings reduces the number of activations.

As Mario has pointed out, we may consider **anti-rules**. Then a blocking could be considered as an **anti-activation** of a rule and we could use **annihilation of rules** in the form $(r, t)(r, t)^- \rightarrow \lambda$.

Conclusion

- ▶ As usual, the spirit of the BWMC has been very inspiring for us!
- ▶ We had very interesting discussions, especially with the members of the Sevillan team.
- ▶ Hopefully we will be able to write a lot of contributions for conferences and journals.
- ▶ And we had a lot of great food, chocolate, churros, ...

THANK YOU VERY MUCH!

¡MUCHAS GRACIAS!