This thesis contributes a number of expressiveness results and concludes with an interesting new approach to multi-synchronization in process algebra. It is clearly written and technically solid overall. I therefore recommend that it satisfies the obligations of a PhD.

The introduction discusses the connections to systems biology.

Chapter 2: This chapter shows how to simulate simporter/antiporter P-Systems by (non-Turing complete) MBD Brane Calculi, providing a lower bound on the computational power of MDB Brane calculi. The encoding is based on 'syn' actions and coactions that are defined contextually to kind of adjacency of membranes, and it needs to emulate the maximum parallelism semantics of P-Systems via a controller process that activates a maximal number of encoded rewrite rules and detects when no more rules can be applied.

Chapter 3: This chapter deals with the 'local implementation problem' of how to simulate n-way rewrites (in kappa calculus) with binary interactions (in nano-k, i.e. with bond flipping). [N.B. the problem is called 'self-assembly' but this is such a horrible and misleading name that I refuse to call it such: self-assembly means something completely different in biology and nanotechnology; the problem here has nothing to do with 'self' and nothing to do with 'assembly'.] A solution to the local implementation problem is provided where deadlocks are avoided by non-termination: it seems unlikely that nontermination can be avoided, and it is show that under 'reasonable' assumptions this is impossible.
Two calculi with binary interactions are considered: mK allows multi-edges, and nano-k allows bond flipping. It was previously known that kappa could be reduced to mk, relying on reversible reactions. The nano-k encoding is similar, but using bond-flipping ('triangular trade') to inspect the correctness of the left-hand-side structure.
A new condition of 'reasonable' encoding is provided (twinning), and an impossibility result is proved. An interesting final remark states that this implies that a stochastic encoding of kappa in nano-k or pi calculus is not possible. Implying that stochastic simulation must be done directly in kappa (as is in fact done).

Chapter 4: This chapter studies leader election problems in various fragments of k. In particular it identifies small fragments of both nano-k and kappa with various degrees of expressive power. The ps^n calculi allow rewrites only between connected molecules, and are such that ps^n is less expressive than ps^n+1. It is shown that ps^n cannot solve leader election of sufficiently large ring networks. Instead, ps^2 can solve elections for fully connected networks of any size, and two extensions can also solve leader election of arbitrary networks: either ps^2 plus bond flipping (as in nano-k) or ps^3 plus bond creation (as in kappa). Most striking is therefore the power of bond flipping.

Chapter 5: The final chapter investigates multi-party synchronization in a purer framework, inspired by the interesting but more domain-specific results of the previous chapters. CCS^n is an extension of CCS with multiple-input prefixes [a1,...,am].P with m <= n. It is defined by an interesting new technique of multi-labeled reductions, in order to properly handle partially-restricted input prefixes. It is first shown (by dining philosophers problems) that there is no 'reasonable' encoding of CCS^n+1 in CCS^n. Then CCS^n is generalized to multiple (input and output) prefixes, and then prefixes of length 3 can encode all the longer prefixes. Still, prefixes of length 2 are not sufficient.

[Correction; 'unsensible to divergence' --> 'insensitive to divergence']

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