Normed BPA vs. Normed BPP Revisited*

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Decidability and complexity of bisimilarity on various classes of processes is a classical topic in process algebra and concurrency theory. One long-standing open problem is the decidability question for the class PA (process algebra), which comprises "context-free" rewrite systems using both sequential and parallel composition. For the subcase of *normed* PA, a procedure working in doubly-exponential nondeterministic time was shown by Hirshfeld and Jerrum (1999). The most difficult matter in this algorithm is the case when (a process expressed as) sequential composition is bisimilar with (a process expressed as) parallel composition. A basic (sub)problem of this problem is to analyze when a BPA process is bisimilar with a BPP process. Černá, Křetínský, Kučera (1999) have shown that this (sub)problem is decidable in the *normed* case; their suggested algorithm is exponential. Decidability in the general (unnormed) case was shown (without giving any complexity bound) by Jančar, Kučera, Moller (2003).

We revisit the normed case, and we present a *polynomial time* algorithm deciding whether a given normed BPA process α is bisimilar with a given normed BPP process M. The main idea is to derive a polynomial bound for the "finite-state core" of the transition system generated by the BPP process M. To this aim we provide a new algorithm, based on *dd*-functions, with time complexity $O(n^3)$, which transforms a given normed BPP process into a "prime form", where bisimilarity coincides with equality. If the constructed finite-state core exceeds the derived bound, we answer negatively; otherwise we construct a BPA process α' which is bisimilar with M, and the final step is to decide if BPA processes α and α' are bisimilar. This final step can be handled by some known algorithm deciding bisimilarity of normed BPA (e.g. Lasota, Rytter, 2006). We also sketch a simple self-contained algorithm which uses the fact that α' is close to a finite-state system. This should lead to a better complexity estimation, though we provide no analysis here.

This presentation is based on the paper accepted to CONCUR 2008 and published in its proceedings - Franck van Breugel and Marsha Chechik (Eds.): CONCUR 2008 - Concurrency Theory, 19th International Conference, Toronto, Canada, August 2008. Proceedings. Lecture Notes in Computer Science 5201, Springer 2008, ISBN 978-3-540-85360-2.

* The authors acknowledge the support by the Czech Ministry of Education, Grant No. 1M0567.