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Transformational semantics of the combination π-*OZ* for mobile processes with data

Masterarbeit

- post version -

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1 Introduction

In many cases of modern computing it is of interest to describe and model concurrency. Computers no longer just solve a problem by subsequently working off the single tasks of their own, but they decompose and concurrently calculate the problem even together in a network. The increase in the number of CPU cores and more heavily of GPU cores within one single computer convincingly demonstrates how fundamental concurrency is for modern computing. Moreover, the rapidly increasing spread of the Internet is one of the most common examples which shows the importance of networks.

This thesis is divided into five chapters. In Chapter 2 we briefly introduce sequences and properly investigate the π-calculus and its operational semantics (the *early transition system* [SW01]). Thereby, we investigate its properties and define the refinement based on the trace semantics. Finally, the conclusion in Chapter 3 gives a brief summary of our results and presents ideas for future work.

2 Preliminaries

At the heart of the refinement of *π-calculus* processes is the theory of *sequences*. Thus, in this chapter, we recall the model of sequences to gain a formal construct to handle ordered elements.

Furthermore, we introduce the π-calculus and investigate its behavior properly. In particular, we carefully explain the operational semantics of π-calculus processes, since its peculiarities induce the characteristics of the refinement and its properties. Moreover, we discuss why we choose this particular operational semantics for the following work in this thesis and compare it to other semantics.

The majority of those definitions and notions can, for example, be found in [Mil99, SW01].

As mathematical notations, we consider the natural numbers starting with zero ($\mathbb{N} = \{0, 1, 2, \ldots\}$) and use $\fatsemi$ as the composition of relations. Furthermore, we denote R^* as the reflexive and transitive closure of a relation R.

2.1 The π-calculus

The *π-calculus* belongs to the family of ...

2.1.1 Syntax

Definition 2.1.1 (Syntax) The syntax of a π-calculus process P is defined by:

$$P ::= \sum_{i \in I} \pi_i.P_i \;\Big|\; P_1 \mid P_2 \;\Big|\; \underline{\texttt{new}}\, a\ P.$$

where:

- $\sum_{i \in I} \pi_i.P_i$ is the guarded sum.
- $P_1 \mid P_2$ is the parallel composition of processes.

- new a P is the restriction of the scope of the name a to the process P $*$

guarded sum

guarded sum

guarded sum

2.2 The OZ

The OZ

3 Conclusion and future work

In this thesis ...

Bibliography

[Mil99] R. Milner. *Communicating and Mobile Systems: the π-Calculus*. Cambridge University Press, Cambridge, England, 1999.

[SW01] D. Sangiorgi and D. Walker. *The π-calculus: a Theory of Mobile Processes*. Cambridge University Press, Cambridge, England, 2001.

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Erklärung

Hiermit versichere ich, dass ich diese Arbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe. Außerdem versichere ich, dass ich die allgemeinen Prinzipien wissenschaftlicher Arbeit und Veröffentlichung, wie sie in den Leitlinien guter wissenschaftlicher Praxis der Carl von Ossietzky Universität Oldenburg festgelegt sind, befolgt habe.

Oldenburg, den 16. Januar 2020

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(Muhammad Ekbal Ahmad)