

ABSTRACT

This thesis describes the construction and mathematical properties of a model for communicating sequential processes. We define a semantic model for processes based on *failures*, which encapsulate certain finite aspects of process behaviour and allow an elegant treatment of nondeterminism. We define a set of process operations, including nondeterministic choice, conditional composition, and various forms of parallel composition. These process operations enjoy many interesting mathematical properties, which allow us to prove many process identities. The failures model is well suited to reasoning about deadlock properties of processes, and some examples are given to illustrate this.

The failures model does not treat in a reasonable way the phenomenon of divergence, which occurs when a process performs a potentially infinite sequence of internal actions and never interacts with its environment. We offer an extension of the model in Chapter 5, which treats divergence more satisfactorily. We also give a complete proof system for proving semantic equivalence of terms.

The thesis also contains some results on the relationship of these models to other models of processes in the literature, specifically relating to the work of Milner, Kennaway, Hennessy and de Nicola. Chapter 3 gives an alternative formulation of the failures model, allowing comparison with Kennaway's work. Chapter 4 uses Milner's synchronisation trees as the basis for representing processes. In Chapter 6 we show how links can be established between Kennaway's model, the work of Hennessy and de Nicola, and our failures model; this chapter focusses on modal assertions of various kinds about process behaviour. We show that by varying the class of assertions we can characterise different semantic models.