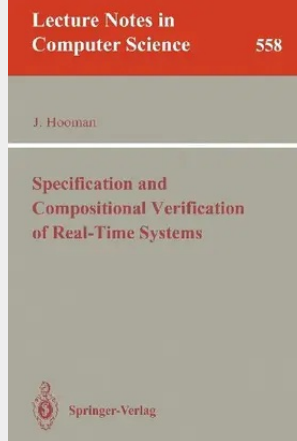


Specification and Compositional Verification of Real-Time Systems

The research described in this monograph concerns the formal specification and compositional verification of real-time systems. A real-time programming language is considered in which concurrent processes communicate by synchronous message passing along unidirectional channels. To specify functional and timing properties of programs, two formalisms are investigated: one using a real-time version of temporal logic, called Metric Temporal Logic, and another which is based on extended Hoare triples. Metric Temporal Logic provides a concise notation to express timing properties and to axiomatize the programming language, whereas Hoare-style formulae are especially convenient for the verification of sequential constructs. For both approaches a compositional proof system has been formulated to verify that a program satisfies a specification. To deduce timing properties of programs, first maximal parallelism is assumed, modeling the situation in which each process has its own processor. Next, this model is generalized to multiprogramming where several processes may share a processor and scheduling is based on priorities. The proof systems are shown to be sound and relatively complete with respect to a denotational semantics of the programming language. The theory is illustrated by an example of a watchdog timer.

This monograph presents two formal methods for the specification and compositional verification of real-time systems. One uses a real-time extension of temporal logic and the other is based on extended Hoare triples. Programs consist of concurrent processes with synchronous message passing. The maximal parallelism model is extended to multiprogramming.



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