Review of the book
Deadlock Resolution in Automated Manufacturing Systems A novel Petri net approach
by Z.W. Li, and M.C. Zhou, Springer, 2009*

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The field of *Discrete Event Systems* (DES) is a research area that combines different formalisms, methodologies and tools from control theory, computer science and operations research. The research activity in this field is driven by the needs of many different applications domains: manufacturing, process control, supervisory control and data acquisition systems, failure diagnosis, software engineering, transportation, and so on.

One important class of problems for untimed DES deal with *deadlock resolution*, i.e., ensuring that the system does not reach a blocking condition from which no future evolution is possibile. There exist different facets of this general issue: *deadlock detection and recovery* allows the system to reach a deadlock provided a blocking condition can be detected and the system can be re-initialized to a nonblocking state; *deadlock prevention* imposes at the design stage restrictions on the behavior of the system to ensure that blocking states can never be reached; *deadlock avoidance* aims to design an on-line control law that keeps the system away from blocking states.

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Deadlock resolution problems are particularly significant in the domain of automated manufacturing. They are practically difficult to solve, and they often entail a trade-off between the optimality of a solution and its computational complexity.

Among the different approaches that can be used to address deadlock resolution problems, *Petri nets* have received a lot of attention in recent years. A Petri net is an algebraic and graphical model endowed with primitives to explicitly represent the notion of concurrency among events. The most significant contribution of Petri nets in this context is the fact that they offer a structured model of DES dynamics, thus often allowing the designer to derive computationally efficient algorithms for controller synthesis, based on the structure of the net without resorting to the exhaustive enumeration of its state space. In particular the notion of siphon (i.e., a set of places that cannot be marked anymore once it has become empty) is a fundamental structural notion for addressing deadlock in Petri nets.

This excellent book collects, in a clear and comprehensive fashion, many results appeared in the literature in recent years concerning Petri nets and deadlock resolution. Although the authors have published important contributions in this field, the book in not exclusively focused on their results; on the contrary, it provides a broad and deep survey of the field. Chapter 1 contains a clear introduction to the problems addressed in the monograph and includes a detailed review of the literature. Chapter 2 presents the considered Petri net models, namely generalized place/transition nets, and describes their structural properties. Chapter 3 discusses the technical notion of elementary siphons. Chapter 4 recalls the control approach based on monitor places to enforce a class of specifications called Generalized Mutual Exclusion Constraints (GMECs) and shows its relevance to deadlock control. In Chapter 5 several deadlock prevention policies are presented, with a particular focus on interesting subclasses of Petri nets. Chapter 6 deals with a more general problem, i.e., optimal liveness-enforcing, that for particular classes of nets can be framed as a simpler deadlock avoidance problem. Chapter 7 contains a very interesting comparison among different Petri net deadlock prevention policies appeared in the literature. Finally Chapter 8 draws the conclusion of this work and highlights some open issues for future research.

The presentation of the material is extremely rigorous, clear and rich in examples. Each chapter is complemented by a set of problems and a by a comprehensive list of references. This makes the book useful for graduate students, engineers and researchers that are interested in solving deadlock resolution problems using Petri nets.