论文与报告

基于Petri网的柔性制造系统一种预防死锁方法

李志武,王安荣

西安电子科技大学机电工程学院,西安

摘要
基于Petri网的结构特性分析,研究了FMS(柔性制造系统)一种预防死锁方法. 提出了 Petri网的一种特殊拓扑结构--基本信标的概念. 在Petri网中基本信标的集合是SMS(严格极小信标)集合的一个真子集. 尤其在大型Petri网系统中,基本信标的集合比SMS的集合要小得多. 对于Petri网的一个子类S3PR,只对每一个基本信标添加一个库所使其不被清空,就可实现预防死锁,也就是说无须控制S3PR的所有SMS而达到无信标被清空的目的. 此外,对于S3PR, 还提出了一种求取SMS和基本信标的方法. 相对于现在普遍采用的控制所有SMS来预防死锁的策略,其具三方面优势. 1)只需控制少量的SMS即所谓的基本信标. 相应地,添加少量的控制库所和连接弧,就可得到无死锁或活的Petri网. 2)不需要先行计算出极小信标的集合. 3)明显地,这种方法更适合大型Petri网系统. 我们通过穿插在文中的一个例子来说明这些方法.

关键词　　Petri网　预防死锁　基本信标　柔性制造系统

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A Petri Net Based Deadlock Prevention Approach for Flexible Manufacturing Systems

LI Zhi-Wu,WANG An-Rong

School of Electro-Mechanical Engineering,Xidian University,Xi'an

Abstract
A deadlock prevention strategy for flexible manufacturing systems is developed based on Petri nets and their structural analysis. The concept of elementary siphons is proposed, it is a class of SMS (strict minimal siphons) with a smaller cardinality, particularly in the Petri net models of large-scale systems. By adding a control place for each elementary siphon to make it never be emptied, deadlocks can be prevented for a special class of Petri nets, namely S3PR. That means not all SMS need to be considered when ensuring no siphon loses its tokens. For S3PR, An approach is proposed for finding elementary siphons and SMS. Compared with the existing methods that control all SMS in a Petri net, the deadlock prevention policy has at least three advantages: 1) only a smaller number of SMS need to be controlled, hence the deadlock-freeness or live Petri net model obtained has less additional places and arcs; 2) not need to compute the set of siphons beforehand and 3) this policy is more suitable for large-scale Petri nets. These methods are illustrated with an example.

Key words　　Petri nets　deadlock prevention　elementary siphon　FMS

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通讯作者　李志武,王安荣

作者个人主页　李志武;王安荣

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