**A deadlock prevention policy for a class of timed Petri nets based on transition priority**

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Petri nets have been recognized as a powerful, graphical, and mathematical tool and widely used to model flexible manufacturing systems (FMS). To solve the problem of deadlock prevention for timed Petri nets (TdPN), an effective deadlock prevention policy based on the transition priority is presented in this poster. By analyzing reachability graphs of TdPN, a new class of TdPN named $TdS^3PRC$ is defined. Three algorithms are proposed based on a new definition named timed Petri nets with priorities (TdPNWP). Algorithm 1, named C-class algorithm, is used for judging whether a $TdS^3PR$ is a $TdS^3PRC$. Algorithm 2, named C-free algorithm, makes a $TdS^3PRC$ deadlock-free. And algorithm 3, named C-live algorithm, makes a $TdS^3PRC$ live. Finally, a parameterized example is used for demonstrating the application of the proposed policy.

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**Timed discrete event models for hierarchical controllers of urban traffic**

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This poster considers efficient hierarchical control of large urban networks, partitioned in smaller geographical regions. Efficient models and performance analysis tools that enable the synergistic design of local or regional control of the switching times of traffic lights in each region on the one hand, and perimeter control at the boundaries of regions at a slower time scale, on the other hand, is proposed in this poster. At the same time the poster illustrates the interaction between the discrete event models used for the control of red/green switching times, at the time scale of cycles of the traffic lights, and the continuous average flow models underlying perimeter control. Timed discrete event systems (DES) models describe the delay of vehicles crossing the different links, and the queues at all the intersections of the region, and the operation of the traffic lights in each region. Model based, coordinated feedback control of the operation of the traffic lights can reduce the delay of all vehicles, as long as the overall density of vehicles remains below some threshold. These regional controllers fail to achieve acceptable performance if the density of vehicles in a region exceeds some threshold. A hierarchically higher level of perimeter control guarantees that the traffic density in the region under control remains below this threshold. This perimeter control uses the macroscopic fundamental diagram (MFD), describing the achievable average flow rate for different traffic densities. The results so far show scalable design can achieve significant improvement in the performance of urban traffic controllers.

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## Fault diagnosis in partially observed Petri nets using redundancies

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Discrete event systems (DESs) are a class of man-made systems that emerge from the extensive deployment of computer and information technology. Driven by the occurrences of events, a DES is characterized by a discrete state space. With the development of industrialization, DESs play more and more important roles in industrial processes, communication networks and transportation. Fault diagnosis is an important research aspect in the area of DESs and is fundamental for fault recovery capabilities in operating large and complex systems. As the complexity of DESs increases, a DES is fault-prone and fault diagnosis is critical and essential in industrial applications. In the past decades, a deluge of studies on fault diagnosis has been done. For the diagnosability issue based on Petri nets, faults can be described by two different ways: 1) faults are modeled as special transitions or places; 2) faults are expressed as failures on the original transitions or places. Following the first line, prior knowledge on faults is necessary since the special transitions or places need to be added when the Petri net is built. Some works also require specific assumption on the structure or initial marking of the net. Although the other line of fault diagnosis do not require the prior knowledge on faults, it detects and identifies faults based on the current marking and initial marking of the system, which means that all places are observable is the fundamental of it. In our work, to be more practical, faults are modeled as abnormal events occurring on the transitions or places in the framework of partially observed Petri nets (POPNs). It means that the priori knowledge on faults is unnecessary and unobservable places are acceptable. The sufficient conditions for the diagnosability of faults are discussed in without any special assumption on the structure and initial marking of the net. Based on the sufficient conditions an method is proposed to build redundancies for POPNs to make it influential faults diagnosable with that the redundancies do not influence the behavior of the original POPNs. Then, we employ Nearest Neighbour Decoding to diagnose the occurrences of faults. The main contribution of our work is the method to diagnose the occurrences of up to k places faults and one transition faults at one time epoch. We demonstrate that the diagnosis schemes can be used for achieving fault tolerance and provide several characterizations of the redundant systems.

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## Fault diagnosis based on the structure information of partially observed Petri nets

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In this paper, we present a fault diagnosis approach for a class of partially observed Petri nets using its structure information. With a novel graph named Diagnosis Marking Path Graph (DMPG), the proposed method does not need traverse all states of the discrete event system. For the considered Petri net, some of its transitions are unobservable including all the transitions representing faulty behaviors. In particular, a concept of diagnosis node is firstly defined. Then three diagnosis states of faults are presented based on the analysis of a DMPG, which is constructed with the structure information of Petri nets and can separate the paths into different sets. Moreover, the validity of the method is illustrated using an example. Finally, the computational complexity of this method has been discussed.

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**Analysis of energy-efficient vehicle assembly systems based on R-TNCES**

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Recent research indicates that dynamic reconfiguration techniques can be applied to manufacturing systems to reduce energy consumption by switching energy-intensive components timely between their working and idle modes during system runtime, since these components consume less energy in their idle modes than in their working modes. The current work studies manufacturing systems with such dynamic reconfiguration techniques by abstracting them as reconfigurable discrete event systems, since only their logic behavior and properties are investigated. The formalism, RTNCES (reconfigurable timed net condition/event systems), is used as a system modeling and analysis tool, which is an extension of well-known Petri nets. System reconfigurations are simulated by command inserting, whose implementation time points are computed a priori by a proposed algorithm. Finally, qualitative analysis specified by computation tree logic and quantitative analysis regarding to energy-efficiency is performed by using the software SESA. The work shows that the R-TNCES formalism has application potential to optimize design proposal of industrial reconfigurable systems.

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**A learning-based synthesis approach to the supremal supervisor of discrete-event systems**

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This study presents a novel approach to synthesize a supremal supervisor in the discrete-event system (DES) in the case that the logical model of the specification is not available. The presented approach is based on supervisory control theory (SCT) of DESs and the $L^*$ algorithm for regular language inferring. The proposed algorithm can construct a supervisor which is identified through the interaction between the plant, designer and the algorithm. A small example is given to illustrate the use of the proposed approach.

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**Supervisory design based on transition priority for a class of Petri nets**

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Deadlock is an undesirable phenomenon in flexible manufacturing systems (FMS). It may not only reduce productivity but also result in major economic losses, even disastrous consequences. Therefore, it is necessary for an effective FMS control policy to ensure that deadlock never occurs. Petri nets are a powerful tool and wildly used to model and control FMS. In my work, based on transition priorities, a deadlock prevention policy for FMS that can be modeled by a class of Petri nets, called S3PR, is developed. First, given a Petri net, its reachability graph is computed where reachable markings can be categorized into good, dangerous, bad, deadlock, and local isolated loop (LIL) markings. Then, to prevent the system from reaching illegal markings ( bad, deadlock and LIL markings), a new class of Petri nets with transition priorities is defined. An algorithm based on it is developed to eliminate the illegal markings. Furthermore, iterative synthesis approach is also adopted which can guarantee that the controlled Petri net is live. The supervisor is obtained. The proposed deadlock prevention policy is generally applicable, easy to use, effective, and straightforward. The resulting net has simple structure. Finally, an FMS example is used to illustrate the proposed approach.

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**Finite-time consensus of switched multi-agent systems**

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This paper focuses on the finite-time consensus of the switched multi-agent system which is composed of continuous-time and discrete-time subsystems. Two types of consensus protocols (the finite-time consensus protocol and the fixed-time consensus protocol) are proposed for the switched multi-agent system in strongly connected network and leader-following network, respectively. By using algebraic graph theory, Lyapunov theory and matrix theory, the finite-time consensus problem can be solved. When the initial states of agents are not available, the fixed-time consensus protocol is applied to solve the finite-time consensus problem. Simulations are provided to illustrate the effectiveness of our theoretical results.

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**Consensus of multi-agent systems with distance-dependent communication networks**

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In this paper, we study the consensus problem of discrete-time and continuous-time multi-agent systems. The communication weight between any two agents is modeled as a nonincreasing function of their distance. Firstly, we consider the networks with fixed connectivity. In this case, the interaction between adjacent agents always exists but the influence could possibly become negligible if the distance is long enough. Secondly, the networks with distance-dependent connectivity are considered. We make an assumption that any two agents interact with each other if and only if their distance does not exceed a fixed range. With the validity of some conditions related to the property of the communication network, we prove that consensus can be asymptotically achieved. Finally, the results are applied to solve the coordination problem of opinion dynamics and the Cucker-Smale flocking model.

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## Flexible multi-agent architecture for an optimized platoon

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Safety of vehicular platoons remains a critical challenge that is still open for investigation. Formal methods are typically used to provide abstract models for platoons to analyze their safety and performance. However, their level of abstraction may lead to inaccuracies with respect to the realworld, in particular in the use of complex systems such as platoons. Simulation is a more convenient alternative when the complexity is high. In this paper, an accurate simulation model for vehicular platoons using Webots is presented. This simulation model considers the kinematics and dynamics aspects of the platoon and its physical constraints. In addition, longitudinal and lateral PID controllers are designed and operation modes are presented. Using the Webots simulation model, the performance of the vehicular platoon is evaluated and analyzed with five vehicles for different scenarios, including normal/degraded operating modes, different speeds, full brake scenarios and various Global Positioning System accuracy. Results show the efficiency of the platoon controller even in a degraded mode that we define. This is proven by the good trajectory matching quality and a small average error from the target safety distance (less than 25%). However, in full-braking, oscillations may happen while the safety distance is always satisfied. In addition, using leader-to-follower communication proves to be as a better approach than simply relying on only distance sensors to maintain the safety distance.

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## Follower consensus of multi-agent systems with antagonistic leaders

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In this paper, we study follower consensus of multi-agent systems with antagonistic leaders. An antagonistic leader can be an exogenous attack or a malicious agent who sends misinformation to others. We consider a model of multi-agent system consisting of antagonistic leaders and followers. In the process of state updating, the agents interact with each other by employing a gossip-like algorithm. Based on graph theory and matrix theory, we obtain some criteria for solving follower consensus. Moreover, we show that the follower consensus in different senses is equivalent. Simulation example are provided to illustrate the effectiveness of our theoretical results.

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**Maximizing the propagation of influence through a social network**

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Research on social networks has exploded over the last decade, especially the influence maximization problem. It is a fundamental problem to mine a subset of most influential individuals with size k in a social network such that they will influence the largest number of individuals evolving in the network (final adoptions of the new product or innovation) by targeting them initially (e.g., to adopt a new product or innovation). Unfortunately, it is proved to be a NP-hard problem under two classical diffusion models (Linear Threshold model and Independent Cascade model). Based on submodular functions, a natural greedy algorithm has been firstly proposed to obtain a solution that is provably within 63% of the optimal. However, it is computationally expensive and is not efficient for large scale networks. An individual's influence always depends on its out-neighbors and will be changeable during the evolution of the propagation. This poster considers a new recursive approach to estimate individual's influence and find the top-k influential individuals to obtain the maximal propagation under Linear Threshold model. Both the experiments on real social networks and comparison with other existed methods will be shown.