Deadlock prevention in Petri nets based on structural theory

Petri nets are widely used for DES modeling and control. Deadlock prevention achieved by using an off-line computational mechanism can be realized by adding monitors to a Petri net system to forbid deadlock states. Structural properties of Petri nets have been successfully exploited for the design of supervisors for supervisory control problems. As a set of place elements, a siphon is a structural object in Petri nets. The liveness of a Petri net is closely related to the satisfiability of certain predicates on siphons. However, the power of siphon-based liveness-enforcing approaches is degraded and deteriorated as the number of siphons grows quickly beyond practical limits and in the worst case grows exponentially fast with respect to the Petri net size. Elementary and dependent siphons in a Petri net play a key role in the development of structurally simple liveness-enforcing supervisors. It is shown that a dependent siphon can be implicitly controlled by properly supervising the number of tokens staying in its elementary siphons. This talk will present siphons, elementary siphons, and their controllability in ordinary Petri nets. And further discuss the extended application of elementary siphons in generalized Petri nets by combining the typological structure and weights information of a net system.