Research Interests

A detailed description of research and people of the laboratory of Automation and Control can be found on:

http://dee.poliba.it/LabControlli/index.htm

1. Discrete event systems
2. Petri net and Colored Petri nets.
3. Control and modeling of automated manufacturing systems.
4. Control and modeling of automatic guided vehicle systems, automated storage and retrieval systems, railway networks, traffic networks.
5. Supply chain modeling and management.
6. Health care system modeling and management
7. Structural properties of linear systems.

Details on Current Research Interests

1 Identification and fault detection of discrete event systems.

Numerous modern man made systems can be modelled as Discrete Event Systems (DES), whose dynamics is asynchronous and whose state transitions are initiated by events that occur at discrete time instants. The research investigates on basic problems in discrete event system framework: the on line identification of a model to describe discrete event systems and the specification of a diagnoser for fault detection.

System identification deals with choosing mathematical models from a known model set to characterize the input-output behaviour of an unknown system from finite. The research investigates on the identification of a Petri net modelling the DES by the real time observation of its dynamical evolution. Moreover, a critical task of large and complex systems is failure analysis. Failure analysis consists in monitoring the system behaviour and in determining the occurrence of any fault and identify its type or origin. The research addresses this problem by using on-line techniques that monitor the system dynamics and decide whether the system behaviour is normal or exhibits some possible faults

2 Modelling and control of automated manufacturing systems

The research addresses the issue of design and control of automated manufacturing systems. In particular, the research focuses on the description and control of the interactions between pieces and resources in manufacturing systems such as the scheduling of the operations and the control of the deadlock situations. In particular the deadlock problem is deeply studied in automated manufacturing systems, transportation systems and storage/retrieval systems. In some basic papers Maria Pia Fanti characterizes deadlock in a graph theoretic framework and proposes several efficient deadlock avoidance policies. Moreover, the presented deadlock avoidance strategies are applied in different application contexts by using suitable modelling tools such as Petri nets and Colored Petri nets.

3 Modelling and control of supply chains and logistics systems

Logistics systems and supply chains (SC) are set of facilities with materials that flow from the sources of raw materials to manufacturers and onwards to consumers of finished products.

The research addresses the issue of design and management the material flow and the inventory stocks in logistics and SC systems at the operational level. In particular, an efficient modular model for SC management and control at the operational level in developed in order to represent material, financial and information flow in an integrated framework. The presented model describes the SC dynamics and formalizes the system control, proposing several controllers able to optimize in a closed loop strategy some suitable performance indices. Some operative SC parameters in short time on the basis of the knowledge of the system state and of the occasional and uncontrollable events that affect the SC behavior.

4 Modelling and control of urban and railway network systems

The research addresses the problems of the urban traffic control and the real time railway network control. In particular, some urban traffic models are proposed in order to determine the signal timing plan on the basis of technical, physical, and operational constraints and in order to simulate the traffic dynamics.

Moreover, the research deals with the railway network real time control that authorizes movements of the trains and imposes safety constraints. In particular the research focused on the deadlock prevention problem. Colored Petri nets are used to model the dynamics of the railway network system and the prevention policy is expressed by a set of linear inequality constraints enforced by adding appropriate monitor places.