Chapter 108
Petri Nets Identification Techniques for Automated Modelling of Discrete Event Processes

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ABSTRACT

One of the ways to perform the reverse engineering of a reactive system is to analyze the model of such a system. However, this model could not exist, or the documentation could not be updated; then a model that describes the current behavior of the system has to be built. Automated modelling of reactive discrete event processes can be achieved through identification techniques, which yield suitable discrete event models from the observed behavior in the form of input-output sequences. This chapter presents an overview of input-output identification techniques that build Petri net models.

INTRODUCTION

Building Petri net models from system behaviour observations is a hard task when the system is large and complex; then, the use of computer-aided modelling tools is useful. Identification techniques have been useful for building systematically models involving events and states. Finite automata and Petri nets have been used as a formalism to describe the functioning of discrete event processes in operation.

Reactive systems are embedded within an environment interacting with other systems. We focus on systems that interact through binary signals, which is the case of discrete event processes. The behaviour of the system is then captured as sequences of vectors whose entries are the values of input-output signals; afterwards, the sequences are processed by an identification method to obtain the discrete event model. This is shown in Figure 1.

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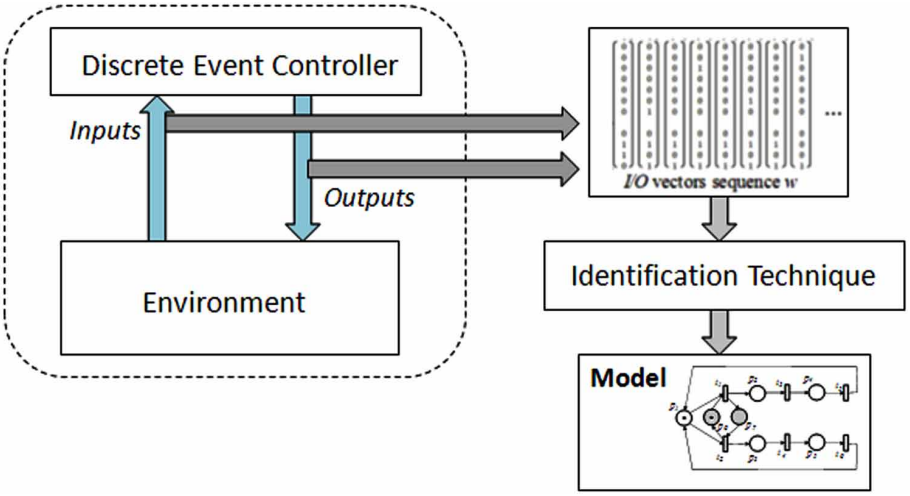
Figure 1.



This chapter surveys relevant identification methods and overviews two approaches that generate models of different levels of abstraction; one that describes in detail the relationship between input events and outputs, and other that yields compact descriptions. Finally, current research problems and trends on discrete event process identification are discussed.

BACKGROUND

1. Identification Methods

1.1. Language Learning Methods

Pioneer works on identification methods can be found in computer science theory, where the problem of obtaining a language representation from sets of accepted words has been dealt since a long time. Such methods are generally referred as *language learning techniques*.

Gold´s method (Gold, 1967) for identification in the limit processes positive samples: an infinite sequence of examples such that the sequences contain all and only all the strings in the language to learn.

The Probably Approximately Correct (PAC) learning technique in (Valiant, 1984) learns from random examples and studies the effect of noise on learning from queries.

The query learning model proposed in (Angluin, 1988) considers a learning protocol based on a "minimally adequate teacher"; this teacher can answer two types of queries: membership query and equivalence query.

Several works adopted state machines as representation model, allowing describing the observed behaviour.

In (Booth, 1967) a method to model a language as Moore or Mealy machines is presented. The method proposed in (Kella, 1971) allows obtaining models representing Mealy machines from a single observed input-output sequence. In (Biermann & Feldman, 1972) a method to identify non deterministic Moore