

Streszczenie rozprawy doktorskiej

mgr inż. Marcin Wojnakowski

I. Title

Analysis of Boundedness and Safeness in a Petri Net-Based Specification of Concurrent Control Systems

II. Thesis

Analysis of boundedness and safeness of concurrent control systems specified by Petri nets can be performed effectively and efficiently.

III. Main Purposes:

- To conduct a broad survey on the boundedness and safeness of Petri net properties;
- To propose novel algorithms for analyzing boundedness;
- To propose novel algorithms for analyzing safeness;
- To verify effectiveness and efficiency of the proposed methods.

IV. Abstract

Control systems can be found in many areas of everyday life, such as banking, medical care, manufacturing, transportation, and entertainment. Their intensive development requires designers to use advanced and multi-functional tools to support the process of their design. Petri nets are one of such modeling approaches. They are increasingly popular, available for analysis, and easily yield to graphic design. Therefore, analyzing boundedness and safeness of systems specified by Petri nets becomes an important challenge. This dissertation provides an extensive overview of applications and algorithms that analyze boundedness and safeness of Petri nets. Boundedness signifies a finite number of reachable states of a control system, whereas safeness characterizes a binary behavior which, combined with a set of logical input and output signals, is used in Petri nets that can be easily implemented in configurable FPGAs. In the absence of sufficiently efficient and effective analytical methods of Petri net properties, due to their exponential computational complexity, novel algorithms are proposed to fill the gap in this area. The introduced solutions are described in detail and supported by a series of experimental findings from a set of 243 Petri nets. Their limitations are also discussed. In addition, a real-life manufacturing control system described on a Petri net, which illustrates the most important benefits of designing concurrent systems by means of bounded and safe nets, was prepared.