PARALLEL REALIZATION OF DECISION-MAKING PROCESSES IN DISCRETE SYSTEMS ON THE BASIS OF NEURAL FUZZY PETRI NETS

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Abstract: This paper presents parallel algorithm of decision-making processes in discrete systems on the basis of neural fuzzy Petri nets (NFPN).

1. Introduction

The analysis of decision-making processes in discrete systems with ambiguity can be realized by neural nets, which are represented by NFPN [1,2,3]. Neural fuzzy Petri nets represent a special kind of neural nets, in which transitions $t_j \in T$ are neurons and places $p_i \in P$ are conditions of realization of neurons. To every place $p_i \in P$ NFPN value of membership function is assigned. The analysis of decision-making processes in discrete systems on the basis of NFPN is based on the propositional fuzzy logic.

Parallel algorithm of realization NFPN (written in parallel programming language OCCAM2 [4]) represents a possibility of technical realization of an analyzer on the basis of transputers.

2. Neural Fuzzy Petri Nets

For the analysis of decision-making processes in discrete systems with ambiguity NFPN can be applied. The properties of NFPN are described in [1,2,3].

The decision-making discrete system with ambiguity is described by a set of k conditions C(1), C(2), ... , C(k) on the basis of which its rules can be constructed [1]. Conditions may be conjuncted and disjuncted in a natural way to allow the firing of neurons. The truth of the conditions (tokens in places $p_i \in P$ in NFPN)

$$C = (C(1), C(2), \ldots, C(k))$$

determines fuzzy truth vector (FTV)

T = (T(1),T(2), ... ,T(k))

by which fuzzy vector of neurons (FVN) is initialized

N = (N(1),N(2), ... ,N(l))

which is assigned to transitions $t_j \in T$ in NFPN. Fuzzy decision-making vector (FDV)

D = (D(1),D(2), ... ,D(l))

can be assigned to FVN that represents threshold of feasibility of FVN N.

3. Parallel Algorithm of Realization of Decision-Making Processes in Discrete Systems with Ambiguity

Parallel algorithm of analysis of decision-making processes in discrete systems on the basis of NFPN can be realized in parallel programming language OCCAM2. The structure of this programming language corresponds to the hardware architecture of transputers. It enables programming of parallel computing trasputer systems. Parallel algorithm of analysis of decision-making processes by means of NFPN can be described in the following way, where the input quantities of algorithm are:

- conditions C, FVN N, FTV T, FDV D;
- forward incidence function I: KxL--→A, where (A = 0,1,2, ...), which is represented by forward incidence matrix I(k,l);
- backward incidence function Q: LxK--→A, which is represented by backward incidence matrix Q(l,k);

Forward and backward incidence function describe the structure of decision-making discrete systems. Parallel algorithm can be realized as follows:

```
SEQ
  b=0
  WHILE (T(k) ≠ 0 AND N(l) ≠ 0)
    SEQ
      b=b+1
      PAR j = 1 FOR l
        NN(j) = N(j)
        PAR i = 1 FOR k
```

```
    - - cycle for processing of rows and columns
    - - of forward incidence matrix I(k,l)
      IF
        I(i,j) = 1
          IF
            NN(j) ≥ T(i)
              NN(j) = T(i)
            TRUE
              SKIP
      TRUE
        SKIP
PAR j = 1 FOR l
- - cycle for comparing of j-th component of new FVN
- - NN and j-th component of FDV D
  IF
    NN(j) < D(j)
      NN(j) = 0
    TRUE
      SKIP
PAR j = 1 FOR l
- - cycle for assigning of j-th components of new FVN
- - NN to j-th componets of FVN N
  N(j) = NN(j)
PAR j = 1 FOR k
  NT(j) = T(j)
  PAR i = 1 FOR l
  - - cycle for processing of rows and columns
  - - of backward incidence matrix Q(l,k)
    IF
      Q(i,j) = 1
        IF
          NT(j) ≤ N(i)
            NT(j) = N(i)
          TRUE
            SKIP
      TRUE
        SKIP
```

```
PAR j = 1 FOR k
- - cycle for assigning of j-th componets of new FTV
- - NT to j-th componets of FTV T
  T(j) = NT(j)
PAR i = 1 FOR l
- - cycle for up-to-dating of i-th componets of FVN N
  IF
    N(i) = 0
      N(i) = 1
    TRUE
      SKIP
```

4. Summary

Neural fuzzy Petri nets, which are a special kind of neural nets, enable to analyze of decision-making processes in discrete systems with ambiguity. Possibilities of this formal mean are based on the knowledge of fuzzy matrix. By means of NFPN concurrency and conflict in discrete systems can be modelled. Neural fuzzy Petri nets can be applied in fuzzy rule-based reasoning and deducing of control systems for real time decision-making with application in control and pattern recognition.

References

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