Developments in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics. Volume I: Foundations

Developments in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics Volume II: Applications

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ISBN 9788389475305

Generalized net model of combined transport between railway and water transport

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Abstract

The present paper describes the process of the Ro-La traffic. The model can be used for process optimization.

1 Introduction

Combined transport between railway and water transport is loading and shipping of goods wagons on ships [6, 7, 8, 9, 10, 11]. They apply in case of a big flow of railway wagons to particular directions.

In Bulgaria, during the 80s of the last century, a big ferryboat complex for this kind of transport was built and worked in the port of Varna. This ferryboat complex was built to ferry services between Varna and Ilichevsk. The necessity for this was huge goods flow between Bulgaria and the Soviet Union in those years, as well as, for the escape from the slow transit of wagons through Romania. In this complex is being realized changing of wagons bogies for different gauge.

Special features of this kind of combined transport are the necessity of many infrastructure developments and special ships. The servicing of wagons and the shipping are really slowly. At first, the wagons enter loaded on trains, then comes the uncouple and passing for the change of bogies. The process of hanging, passing rail and loading to ship is on groups of two or three wagons. All these actions are repeated according to the number of groups of wagons, which must be loaded on the ship.

The crumble of the old economic relationships leads to the ferry line practically being disused. The number of the ships is reduced to only one.

Developments in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics. Volume II: Applications *(K.T.Atanassow, W.Homenda, O.Hryniewicz, J.Kacprzyk, M.Krawczak, Z.Nahorski, E. Szmidt, S. Zadrożny, Eds.), IBS PAN - SRI PAS, Warsaw, 2009.*

At the moments a direct ferry link Varna – Port Kavkaz is being realized. This is a future development of combined transport between road and water for the countries from the Black sea region.

2 A GN-model

The generalized nets are on proper way describe parallel processes such a teaching, organizing [12, 15, 16] and constructing parallel processes [4, 13, 14, 17, 20, 21, 22]

In a several paper we present generalized nets model for other type transport [5, 18, 19].

The generalized net model [1, 2, 3] constructed in Figure 1 describes the process of Ro-Ro traffic.

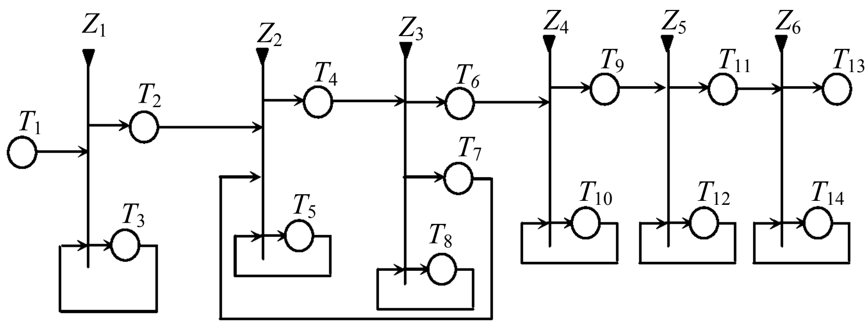

Figure 1: A GN-Model of the Ro-Ro traffic

The places in the generalized net fall into two categories:

- *T*-places standing for the separate wagons;

Sequentially, α-tokens enter the net through place T_1 in some time-moments. These moments will be determined stochastically, when the model is simulated, or they will correspond to real events, when the GN is used for observation of real processes. These tokens have initial characteristic "wagon *i*", $i = 1, 2, \ldots, n$.

3 The generalized net in action

The Generalized Net contains the following set of transitions:

$$A = \{ Z_1, Z_2, Z_3, Z_4, Z_5, Z_6\},$$

where the following transitions represent:

- Z_1 - coming the vehicles on parking;
- Z_2 – uncouple the wagons ;
- Z_3 – change the railway carriage;
- Z_4 - the processes of the freighting;
- Z_5 – process of the sailing;
- Z_6 – process of the unshipping the vehicles on the ship.

The transitions have the following forms.

$$Z_1 = <\{T_1, T_3\}, \{T_2, T_3\}, R_1, \vee (T_1, T_3)>$$

The index matrix of the transition conditions is:

$$R_1 = \begin{array}{c|cc} & T_2 & T_3 \\ \hline T_1 & false & true \\ T_3 & W^T_{3,2} & W^T_{3,3} \end{array},$$

where:
$W^T_{3,2}$ = “ There is a vacant place in the parking lot”;
$W^T_{3,1} = \neg W^T_{3,2}$.

The α–tokens, entering place T_2 do not obtain new characteristics.

$$Z_2 = <\{T_1, T_7, T_5\}, \{T_4, T_5\}, R_1, \vee (T_1, T_7, T_5)>$$

The index matrix of the transition conditions is:

$$R_2 = \begin{array}{c|cc} & T_4 & T_5 \\ \hline T_3 & false & true \\ T_7 & false & true \\ T_5 & W_{5,4} & W_{5,5} \end{array},$$

where:
$W_{5,4}$= “ The wagons are coupled or uncoupled”;
$W_{5,5} = \neg W_{5,4}$.

The tokens, entering place T_4 do not obtain new characteristics.

$$Z_3 = <\{T_4, T_8\}, \{T_6, T_7, T_8\}, R_3, \vee (T_4, T_8)>$$

The index matrix of the transition conditions is:

$$R_3 = \begin{array}{c|ccc} & T_6 & T_7 & T_8 \\ \hline T_4 & W_{4,6} & false & W_{4,8} \\ T_8 & false & W_{8,7} & true \end{array},$$

where:
$W_{4,6}$= “The wagons are coupled”.
$W_{4,8}$= “The wagons are uncoupled”.
$W_{8,6}$= “The wagons are ready for freighting”.

The token, entering place T_6 obtain characteristic: “wagons with different railway carriage”.

$$Z_4 = <\{T_6, T_{10}\}, \{T_9, T_{10}\}, R_4, \vee (T_6, T_{10})>$$

The index matrix of the transition conditions is:

$$R_4 = \begin{array}{c|cc} & T_9 & T_{10} \\ \hline T_6 & false & true \\ T_{10} & W_{10,9} & true \end{array},$$

where:
$W_{10,9}$= “ All vehicles are loads in the ship”.

The token, entering place T_9 obtains characteristics:” full ship”.

$$Z_5 = <\{ T_9, T_{12}\}, \{ T_{11}, T_{12}\}, R_5, \vee (T_9, T_{12})>$$

The index matrix of the transition conditions is:

$$R_5 = \begin{array}{c|cc} & T_{11} & T_{12} \\ \hline T_9 & false & true \\ T_{12} & W_{12,11} & true \end{array},$$

where:
$W_{12,11}$= “The ship is arrive”.

Z_6= <{T_{11}, T_{14}}, { T_{13}, T_{14}}, R_6, ∨ (T_{11}, T_{14})>

The index matrix of the transition conditions is:

$$R_6 = \begin{array}{c|cc} & T_{13} & T_{14} \\ \hline T_{11} & false & true \\ T_{14} & W_{14,13} & true \end{array},$$

where:
$W_{14,13}$= “ There is a unloaded vehicle”;

The tokens, entering place T_{13} obtain characteristics:

” wagon i”, $i = 1, 2, \ldots, n$.

4 Conclusion

The Generalized Net model described here is a possible model for the process of Ro-Ro traffic.

Most of the model parameters can also be regarded as characteristics of tokens from an additional contour, thus achieving optimization with respect to our given aim.

Statistical information would need to be collected in order to monitor the development of the process.

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.
It may be viewed as a result of fruitful discussions held during the Eighth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2009) organized in Warsaw on October 16, 2009 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Centre for Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT – Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bistrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, and the University of Westminster, Harrow, UK:

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The Eighth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2009) has been meant to commence a new series of scientific events primarily focused on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Moreover, other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems are discussed.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

ISBN-13 9788389475305
ISBN 838947530-8
9 788389 475305