САМАРСКИЙ УНИВЕРСИТЕТ
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FUZZY CONTROL IN THE SIMULATION MODEL OF AIRPORT BAGGAGE HANDLING SYSTEMS

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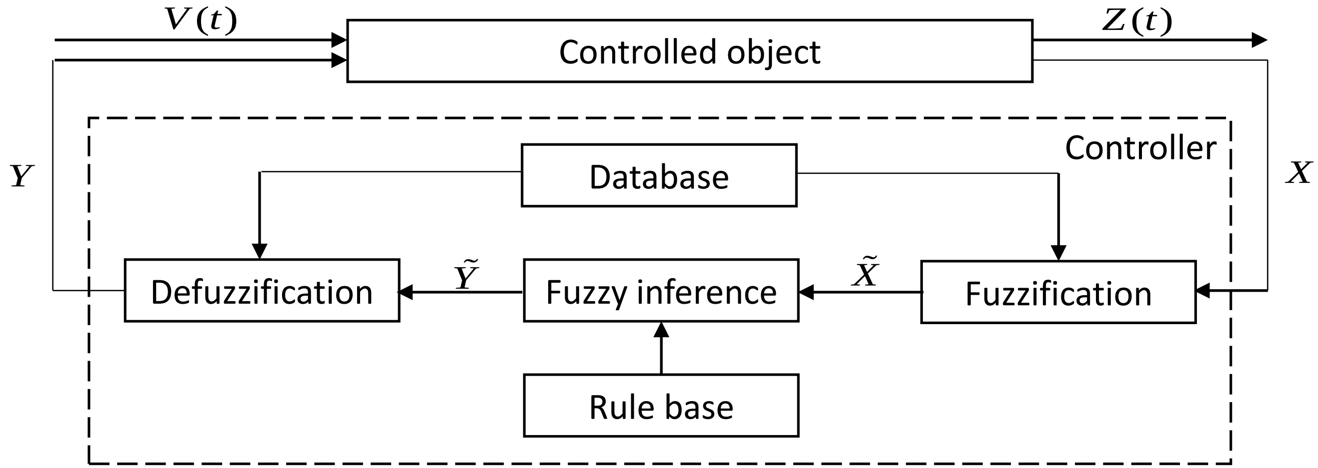
Fuzzy control system model structure



Fuzzification

$$\mu_{\tilde{x}_i^{(k,m)}}(x_i)$$

Fuzzy inference

1. Aggregation:

$$h^k(X^*) = \max_{m=1,\dots,m^k}\left[\min_{i=1,\dots,I}\mu_{\tilde{x}_i^{(k,m)}}(x_i^*)\right], k=1,\dots,K.$$

2. Activation:

$$\mu_{\tilde{y}^{k*}}(y)=\min\left[h^k(X^*),\mu_{\tilde{y}^k}(y)\right].$$

3. Accumulation:

$$\mu_{\tilde{y}^{k*}}(y)=\max_{k=1,\dots,K}\mu_{\tilde{y}^{k*}}(y), y\in\left[y^H, y^B\right].$$

Defuzzification

$$y^* = \frac{\int_{y^H}^{y^B} y\cdot\mu_{\tilde{y}^*}(y)dy}{\int_{y^H}^{y^B}\mu_{\tilde{y}^*}(y)dy}$$

Rule base

$$\bigcup_{m=1}^{m^k}\left[\bigcap_{i=1}^{I}(\beta_i=\tilde{x}_i^{(k,m)})\right]\Rightarrow \omega_j=\tilde{y}^k$$

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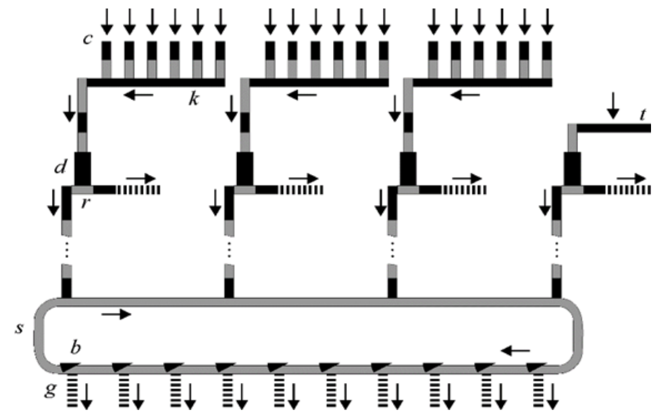
$$z = \left\lceil def\left[\sum_{i=1}^{n} \tilde{z}_i\right]\right\rceil$$

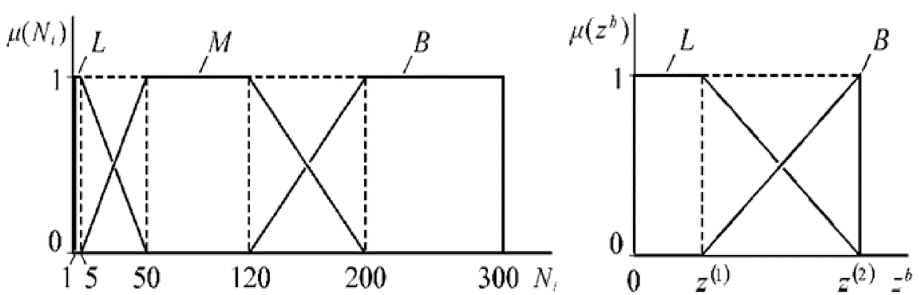
$$\tilde{z}_i = g(N_i, \tau_i, z^b)$$

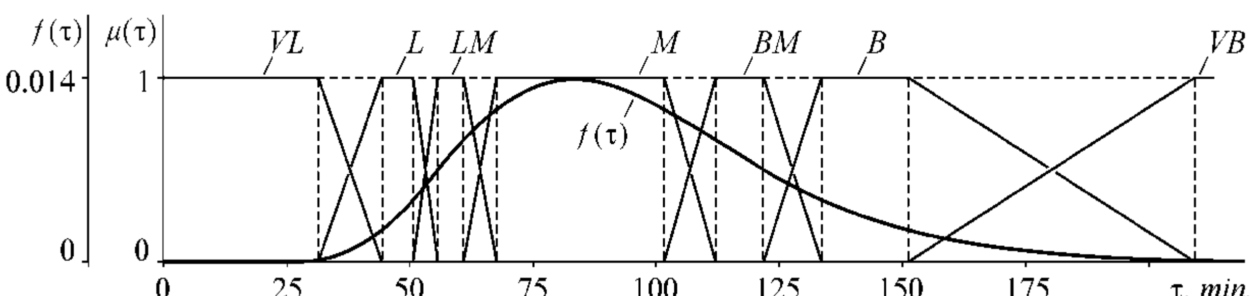
- z – is the workplace number, which should be used for the registration of departing passengers for the next period of time Δt ;
- n – is the number of aircraft, registration for which will be carried out at the moment of the model time $t+\Delta t$;
- $\tilde{z}_i$ – is the fuzzy workplace number that are supposed to be involved in the registration of passengers of the *i-th* aircraft;
- def – is defuzzification;
- $\lceil \cdot \rceil$ – is rounding up to the nearest integer;
- N_i – is the number of departing passengers of the *i-th* aircraft;
- τ_i – is the time interval between the moment of decision (t) and the moment of departure of aircraft *i* according to the schedule;
- z^b – is the number of check-in points already occupied by passenger services at the time of the decision t .

Schematic of a model baggage handling system (BHS)



Membership functions of terms of input linguistic variables





$$\tilde{z}^{bl} = \{L, B\}$$

$$\tilde{N}_i^j = \{L, M, B\}$$

$$\tilde{\tau}_i^k = \{VL, L, LM, M, BM, B, VB\}$$

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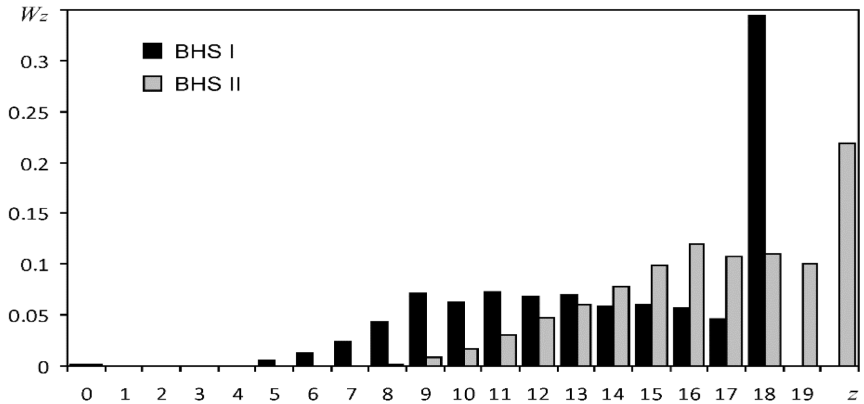
Design options for BHS	BHS I	BHS II
The number of inspection lines	3	4
The number of check-in points on each inspection line	6	5

Results

Indicators	BHS I		BHS II	
	with control	without control	with control	without control
Average passenger waiting time for check-in, sec.	185	78	20	10
Average processing time for initial baggage, sec.	455	380	275	273
Average processing time for transfer baggage, sec.	305	303	280	277
Average time interval from the end of aircraft baggage handling to scheduled departure, min.	30	39	38	42



W_Z - is the frequencies of allocated check-in points number

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