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To classification of intelligent transport systems

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As part of the functioning of the transport infrastructure, various tasks are solved, and the classification of these tasks helps to determine the strategy and tactics for the synthesis of intelligent transport systems (ITS). Here are some typical task classifications:

Traffic and flow control: This category of tasks is related to traffic control and flow control. It includes determining the optimal time intervals for traffic lights, traffic speed control, traffic signs and marking management, planning and synchronization of traffic lights , and other measures to optimize flows and improve traffic efficiency [1].

Road Safety: Tasks in this category are related to road safety and accident prevention. This may include warning systems for drivers about possible dangers, speed control systems, monitoring the condition of road infrastructure and automatic notification of problems on the roads, such as stopped vehicles or road works.

Public transport management: The tasks of public transport management are related to the optimization of routes, timetables and schedules of public transport. It aslo includes planning of optimal routes, synchronization of traffic schedules, determination of stopping points, passenger flow management and electronic ticketing systems [2].

The classical fuzzy control module is used to model traffic control strategies in a transport network node. It consists of the following components:

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Input variables: These are parameters or characteristics that affect traffic management. Examples of input variables might include traffic volume, traffic speed, road congestion, and other factors that can be measured or estimated.

Linguistic variables: Input variables are converted into linguistic variables that describe their state or characteristics using linguistic terms. For example, traffic intensity can be described as "low", "medium" or "high" using linguistic terms.

Knowledge base: The knowledge base contains a set of rules that determine how to manage traffic based on input variables and their linguistic descriptions. These rules are formulated based on expert experience or data analysis and may be of the form "If traffic is high, then increase the green light time."

Fuzzy inference engine: The fuzzy inference engine uses the knowledge base and the current values of input variables to obtain output variables that determine the traffic control strategy. This is achieved by applying fuzzy logic operations such as fuzzy union, fuzzy intersection and unclear implication rule.

Output variables: Output variables represent the results of the simulation and define specific control actions. For example, the output variable could be "green light time".

Defuzzification : Defuzzification converts fuzzy output variable values into specific numerical values or actions. For example, defuzzification can determine how long a green traffic light needs to open.

We define the rule of correspondence to the class of control strategies and assign a degree of truth to each rule.

$$(x_1(1), x_2(1), g(1)) \to R^{(1)}: IF(x_1 \in M_2 AND x_2 \in S) THEN g \in B_1 \quad (1)$$

$$(x_1(2), x_2(2), g(2)) \to R^{(2)}: IF(x_1 \in S AND x_2 \in M_1) THEN g \in S \quad (2)$$

Table 1

Values of data membership functions x_1, x_2, g for certain classes

X1	μ(X1)	X2	μ(X2)	g(i)	mk (g (i))
416	0.84(S)	681	0.81(B2)	38	0.6(S)
434	0.66(S)	670	0.7(B2)	49	0.8(B2)
466	0.66(B1)	864	0.64(B4)	44	0.8(B1)

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Table continuation 1

335	0.65(M1)	795	0.95(B3)	47	0.6(B1)
339	0.61 (M1)	501	0.99(S)	51	0.8(B2)
480	0.8(B1)	502	0.98(S)	37	0.6(M1)
388	0.88(S)	510	0.9(S)	46	0.8(B1)

Here X1 is the number of North-South cars.
X2 - the number of cars West-East.
g(i) - green light time.

Together, these components form a classic fuzzy control module that can be used to model traffic control strategies in a transport network node. The process of the module usually looks like this:

Measurement or evaluation of input variables such as traffic intensity, movement speed and other parameters.

Convert input variables to linguistic variables using appropriate linguistic terms, eg "low", "medium", "high".

References:

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[2] Trofimenko Yu.V., Yakimov M.R. Transport planning: formation of efficient transport systems of large cities: monograph / Yu.V. Trofimenko, M.R. Yakimov. - M.: Logos, 2013. 464 p.