Modeling of group objects motion

Summary

Currently there are a lot of methods of objects motion modeling in various conditions. However it is not clear what must we do in the situations when we can see numerous objects, for example ten, or one hundred, or more objects simultaneously? Consecutive calculation of trajectories of separate objects with subsequent processing often doesn't give us a full picture. In a such situation a calculation of motion characteristics of separate objects loses its meaning. In this case we consider the areas of space in which objects are observed with the highest probability.

For such tasks it is suggested to use the mathematical method of neural networks, realized on special type of computing equipment – neural computers. How can we do it?

The whole area where objects move gets broken into sub-areas of any size. In the center of each i-subarea we place the virtual element - elementary «neuron-state» (ns_i) which can take various values: the value 0(1) means that the object isn't (or is) in this area, and value from the interval [0,1] reflects the degree of probability (or possibility, if we have not any statistic information) of object's location in i-subarea. «Neurons –states» can be connected in networks.

For calculation of the object's parameters it is necessary to know the time interval τ_{ij} of achieving ns_j state starting from some fixed ns_i. So ns_i can be described by coordinates x_i y_i z_i in three-dimensional space, the characteristic α_i describes the possibility or the probability of the location of moving object in subarea ns_i and the time in which the object flies from some subarea ns_j to subarea ns_i . So we can observe the cortege

$$ns_i = \langle x_i\, y_i\, z_i\, \alpha_i\, \tau_{ij} \rangle$$

The idea is to consider a movement as a distribution of some excitation in neuron environment that can be both, accelerated and decelerated. Separate trajectories are considered as neuron networks on which the excitation is transferred. This excitation characterizes a motion of the controlled objects in the space using fixed points (knots of neural network). It is appropriate to model the areas of space where a lot of controlled objects move simultaneously as neurons-state ensembles with various degree of activity. The degree of excitation (activity) of neurons can reflect the number of controlled objects currently located in that space as well as the time when there is a maximum quantity of objects in this space. By changing the activity level, it is possible to identify ensembles (space area) which are more or less active and to control objects' motion during simulation.