UDC 004.896

R. Kryvyy, A. Luno
Lviv Polytechnic National University
Computer-Aided Design Department

THE PECULIARITIES OF GENETIC ALGORITHM OF PLANNING THE ROUTE OF MOBILE ROBOT MOVING

This paper is about finding the optimal route of mobile robots. A genetic algorithm was analyzed and created on the basis of neural net used in this task.

Key words: neural networt, genetic algorithm, mobile robot, route planning task.

Розглянуто особливості знаходження оптимального маршруту мобільних роботів. На основі нейронних мереж, які використовуються у задачі, було проаналізвано і розроблено генетичний алгоритм.

Ключові слова: нейронна мережа, генетичний алгоритм, мобільний робот, задача планування маршруту.

Introduction

Nowadays, creating the robots and applying them to different areas are rapidly developing. Construction simplicity and technological level allow the creation of models with such characteristics that meet the given task. The modern mobile robots are applied to different spheres of human activity, including automatic vacuum cleaner robots as well as robots which help the military to find and neutralize flammable substances. But every robot needs a system which helps it to make its own rout.

The mobile robots managing is usually done by an operator via the control unit, but the tendency to develop the autonomous robotic systems has been spread over the last several years. When a person controls the apparatus, the area where the robot moves is often limited by visibility of so-called “operator”.

The peculiarities of mobile robot moving

The routing problem can be described as the problem of finding the optimal route from one or several starting points into the others scattered over a large area considering all types of limitation (fuel costs, consumption of time and others). When planning the route, we face many problems which have to be sold to provide the effective moving. Such nuances as bypassing the obstacles can be solved with the help of sensors installed in the apparatus with theirs sensitiveness. It is important for mobile robot in case of losing a signal, battery charge inaccuracies or exhaustion to be able to return to the starting point or to choose the suitable place for emergency landing. While using these several apparatus, there is a problem which consists in the necessity of deciding where a robot has to move and what area it has to bypass or which point it has to reach.

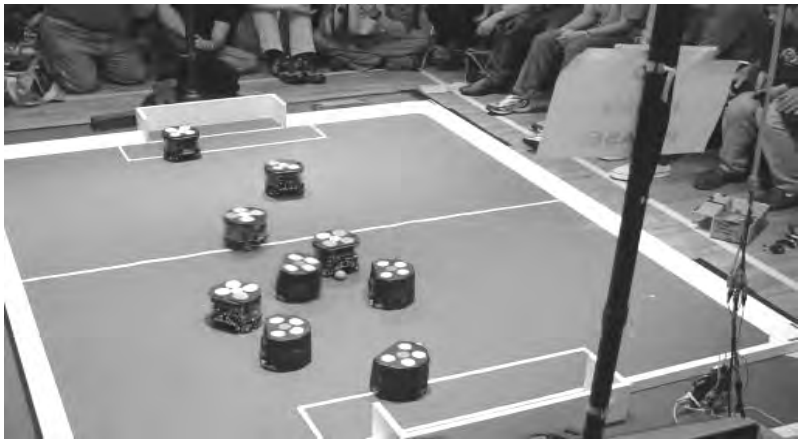

Fig. 1. RoboCup – international robots competition found in 1997.
The aim of this competition is to promote and explore the robots in the field of AI.
The name RoboCup is a short form of "Robot Soccer World Cup",(http://www.robocup.org/)

At present, there is no universal solution that allows to plan the routes effectively. There is a wide spectrum of algorithms, which can be applied to find a partial or full solution of the task given.

The system of making the robot route is one of the most important systems, that provides the functioning of the robot in general. For such system one of the main indicators of work quality is a speed of making the decisions and the optimum of the chosen one.

The use of the neural net for plannung the route

The use of the neural net is a popular way to control the mobile robots. In this case for every scenario robot collects the information about its dynamic environment with the help of installed sensors. The information collected with sensors is presented as an input to the robot's controller performed via engine action.

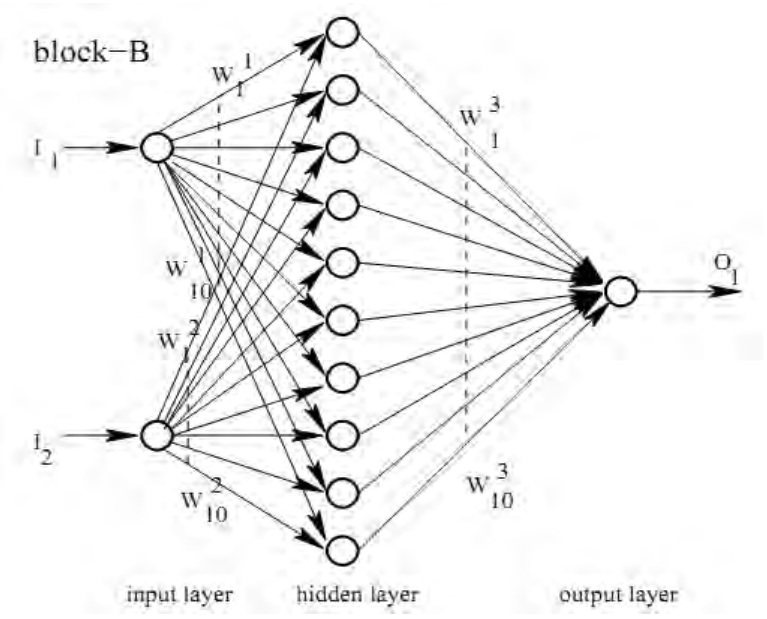

Fig. 2. Neural network

This simple schema shows quite good stable results. The peculiarity of applying weak criteria is dependence of the study quality on "cleanliness" of the initial study conditions. Here it is especially important to start studying in "comfortable" conditions, from simple to complicated one. But increase in amount of receptor signals leads to obvious studying difficulties.

The peculiarities of genetic algorithm in finding the route

Recently, the genetic algorithms have been used for solving this task. The algorithm begins with many ways of making the decisions (chromosomes) called population. Decisions of one population are made and used to create the new one. That is because the new population can be better than the previous(older) one. The decisions chosen to make the new decisions (progeny) are selected with regard to theirs usefulness – the more suitable they are, the more chances for reproduction they have.

The mobile robot is a device with sensors of N and M effects (actuator). Since that, inputting alphabet X=2N signals and output –Y= 2M is a determined automaton with stochastic matrix for all 2N signals. The machine acts in accordance with stochastic matrix P of Q ? X ? Y size, where Q – signals quantity. It means that being in Q(T) condition and receiving the income signal X (T), the end automaton transition is Q (T+1).

With regard to evolution of probabilistic end automatons, which task is to classify study set. The aim of the genetic algorithm is to create the decisions classification which is divided into 2 classes: “positive” (robot’s moving routes) and “negative” (robot’s non-moving routes).

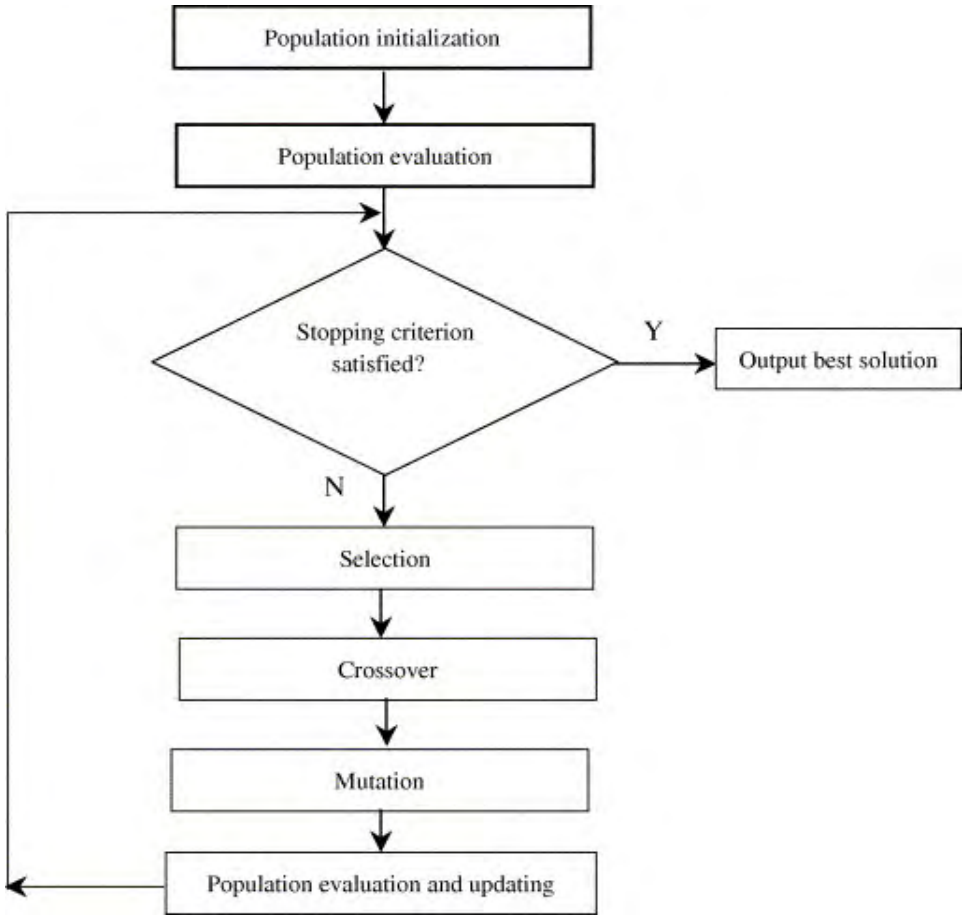

Fig. 3. Genetic algorithm work schema

As a result of genetic algorithm work, people are formed in the population. These people with minimal amount of mistakes classify the input consistency. Then out of received population of automatons {Ai} the most effective individual {Aopt}. This decision is installed into robot as a remote control.

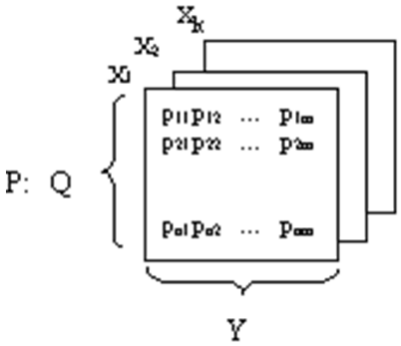

Fig. 4. UML of the genetic algorithm work

The software is being created on the basis of already created genetic algorithm. As a result of software work there has to be a decision transmitted into one or several mobile robots. There is a diagram of software classes in the picture 5.

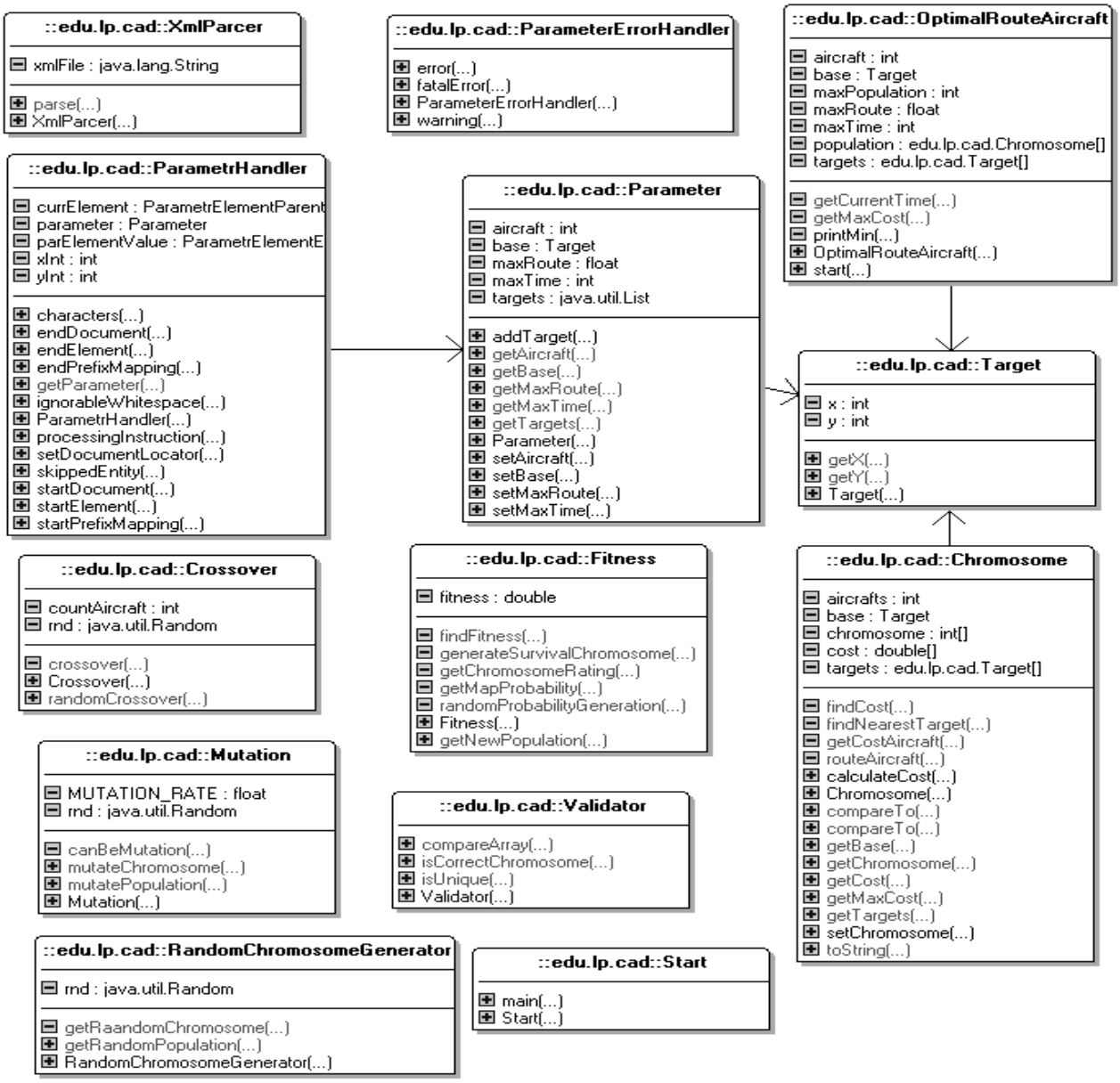

Fig. 5. The diagram of genetic algorithm classes

Conclusion

The unusual object of optimization has to refuse the methods of direct search. As the method of optimization the evolutional search algorithm, a genetic algorithm (GA), was chosen. A new model of GA, where a new way of receiving the output population, was created to be used in a robot. As a result of created GA work, people are formed. Then, out of these people the input sequence with minimal amount of mistakes is created. After this, the most effective individual is chosen.

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