Claims

1. Multiple-objective optimisation device, said device comprising:

- data input means (4);

- first means (2) for defining a criterion for each of the objectives considered on the basis of inputed data;

- second means (5) for automatically achieving multi-criterion optimisation; and

- user means (21),

characterised in that said second means (5) comprise at least:

- a first element (6) for optimising each of said criteria individually, in order to obtain an optimal person (I1 to I6) for each one of these criteria, an optimal person comprising at least one optimal and feasible value for said criterion;

- a second element (8) for determining, using an evolutionary game algorithm, survival coefficients of said optimal persons (I1 to I6); and

- a third element (10) for determining an optimal solution by mutating the optimal persons, using said survival coefficients and of the application of a mutation operator, said optimal solution comprising at least one final optimal value allowing the achievement of all of the objectives considered to be optimised.

2. Device according to claim 1, characterised in that the data inputting means (4) comprise means (15) which allow data to be supplied automatically.

3. Device according to either claim 1 or claim 2, characterised in that the data inputting means (4) comprise means (16) which allow an operator to input data.

4. Device according to any of claims 1 to 3, characterised in that the user means (21) comprise display means which display the optimal solution on a screen.

5. Device according to any of claims 3 and 4, characterised in that the display means and the means (16) allowing an operator to input data form part of a human/machine interface.

6. Device according to any of the preceding claims, characterised in that the device also comprises an element (17) for verifying the feasibility of the optimal solution received from the third element (10), and, in the event of non-feasibility, for determining a new optimal solution corresponding to the feasible solution closest to this optimal solution.

7. Device according to any of the preceding claims, characterised in that the second element (8) comprises:

- means (12) which are formed in such a way as to evaluate, for each of said optimal persons, the performance thereof according to each of the criteria other than the criterion relating to the optimal person considered, so as to be able to obtain an evaluation matrix containing the scores of the optimal persons according to all the other criteria; and
- means (13) which are formed in such a way as to evaluate, using said evaluation matrix and of the evolutionary game algorithm, the survival of the optimal persons according to each of the other criteria, in such a way as to obtain said survival coefficients.

8. Resource allocation system, characterised in that it comprises the device (1) specified in any of claims 1 to 7.

9. System for handling threats in the military field, in particular of the command and control type, comprising weapons assignment for handling the threats, said system (25) comprising:

- a first unit (26) for retrieving information on the situation considered;
- a second unit (1) for processing this information in order to deduce therefrom a engagement proposition, by first of all determining firing windows on the basis of said information, then by deducing therefrom the engagement proposition from these firing

windows, said engagement proposition specifying the weapons assignment and the firing instants for handling the threats; and

- a third unit (27) for implementing a step of approval of the engagement proposition, the engagement being carried out in accordance with a engagement proposition approved using said third unit (27),

characterised in that said second unit comprises the device (1) specified in any of claims 1 to 7.

10. System according to claim 9, characterised in that the first unit (26) comprises at least one radar unit which transmits information on a surrounding situation to said device (1).

11. System according to either claim 9 or claim 10, characterised in that it also comprises a human/machine interface allowing an operator to complete an approval.

12. System according to any of claims 9 to 11, characterised in that it also comprises display means which display the engagement proposition approved by said third unit (27).

13. Multiple-objective optimisation method, according to which the following steps are implemented automatically:

A/ data are generated and a criterion is defined for each of the objectives considered; and

B/ multi-criterion optimisation is achieved which is then used, characterised in that in the step B/ the following successive operations are implemented:

a) each of said criteria is optimised individually in order to obtain an optimal person (I1 to I6) for each one of these criteria, an optimal person comprising at least one optimal and feasible value for said criterion;

b) using an evolutionary game algorithm, the survival coefficients of said optimal persons are determined; and

c) an optimal solution is determined by mutating the optimal persons (I1 to I6), using said survival coefficients and of the application of a mutation operator, said optimal solution comprising at least one final optimal value allowing the achievement of all of the objectives considered to be optimised.

14. Method according to claim 13, characterised in that in the step B/b:

b1) for each of said optimal persons, the performance thereof is evaluated in the form of a score according to each of the criteria other than the criterion relating to the optimal person considered, so as to be able to obtain an evaluation matrix which contains the corresponding scores of the different optimal persons according to all the other criteria; and

b2) using said evaluation matrix and of the evolutionary game algorithm, the survival of the optimal persons (I1 to I6) is evaluated according to each of the other criteria, in such a way as to obtain said survival coefficients.

15. Method for handling threats in the military field, comprising weapons assignment for handling the threats, according to which method the following successive steps are implemented:

α) information on the situation considered is retrieved;

β) this information is processed in order to deduce therefrom a engagement proposition, by first of all determining firing windows on the basis of said information, then by deducing therefrom the engagement proposition from these firing windows, said engagement proposition specifying the weapons assignment and the firing instants for handling the threats; and

γ) a step of approval of the engagement proposition is provided, the engagement being carried out in accordance with a engagement proposition approved in this step γ),

characterised in that in the step β the engagement proposition is determined by implementing the method specified in either claim 13 or claim 14.

Claims

1. A multiple-objective optimisation device, said device comprising:

- data input means (4);

- first means (2) for defining a criterion for each of the objectives considered on the basis of inputed data;

- second means (5) for automatically achieving multi-criterion optimisation; and

- user means (21),

characterised in that said second means (5) comprise at least:

- a first element (6) for optimising each of said criteria individually, in order to obtain an optimal person (I1 to I6) for each one of these criteria, an optimal person comprising at least one optimal and feasible value for said criterion;

- a second element (8) for determining, using an evolutionary game algorithm, survival coefficients of said optimal persons (I1 to I6); and

- a third element (10) for determining an optimal solution by mutating the optimal persons, using said survival coefficients and of the application of a mutation operator, said optimal solution comprising at least one final optimal value allowing the achievement of all of the objectives considered to be optimised.

2. The device according to claim 1, characterised in that the data inputting means (4) allow data to be supplied automatically.

3. The device according to either claim 1 or claim 2, characterised in that the data input means (4) allow an operator to input data.

4. The device according to any of claims 3, characterised in that the user means (21) comprise display means which display the optimal solution on a screen.

5. The device according to any of claims 1, characterised in that the display means and the data input means form part of a human/machine interface.

6. The device according to any of the preceding claims, characterised in that the device also comprises an element (17) for verifying the feasibility of the optimal solution received from the third element (10), and, in the event of non-feasibility, for determining a new optimal solution corresponding to the feasible solution closest to this optimal solution.

7. The device according to any of the preceding claims, characterised in that the second element (8) comprises:

- means (12) for evaluating, for each of said optimal persons, performance thereof according to each of the criteria other than the criterion relating to the optimal person considered, so as to be able to obtain an evaluation matrix containing the scores of the optimal persons according to all the other criteria; and
- means (13) for evaluating, using said evaluation matrix and of the evolutionary game algorithm, survival of the optimal persons according to each of the other criteria, in such a way as to obtain said survival coefficients.

8. A resource allocation system, characterised in that it comprises the device (1) specified in any of claims 1 to 7.

9. A system for handling threats in the military field, in particular of the command and control type, comprising weapons assignment for handling the threats, said system (25) comprising:

- a first unit (26) for retrieving information on the situation considered;

- a second unit (1) for processing this information in order to deduce therefrom an engagement proposition, by first of all determining firing windows on the basis of said information, then by deducing therefrom an engagement proposition from the firing windows, said engagement proposition specifying the weapons assignment and firing instants for handling the threats; and

- a third unit (27) for implementing a step of approval of the engagement proposition, the engagement being carried out in accordance with a engagement proposition approved using said third unit (27),

characterised in that said second unit comprises the device (1) specified in any of claims 1 to 7.

10. The system according to claim 9, characterised in that the first unit (26) comprises at least one radar unit which transmits information on a surrounding situation to said device (1).

11. The system according to either claim 9 or claim 10, characterised in that it also comprises a human/machine interface allowing an operator to complete an approval.

12. The system according to any of claims 9 to 11, characterised in that it also comprises display means which display the engagement proposition approved by said third unit (27).

13. A multiple-objective optimisation method, according to which the following steps are implemented automatically:

A/ data are generated and a criterion is defined for each of the objectives considered; and

B/ multi-criterion optimisation is achieved which is then used, characterised in that in the step B/ the following successive operations are implemented:

a) each of said criteria is optimised individually in order to obtain an optimal person (I1 to I6) for each one of these criteria, an optimal person comprising at least one optimal and feasible value for said criterion;

b) using an evolutionary game algorithm, to determine survival coefficients of said optimal persons; and

c) an optimal solution is determined by mutating the optimal persons (I1 to I6), using said survival coefficients and of the application of a mutation operator, said optimal

solution comprising at least one final optimal value allowing the achievement of all of the objectives considered to be optimised.

14. The method according to claim 13, characterised in that in the step B/b:

b1) for each of said optimal persons, performance thereof is evaluated in the form of a score according to each of the criteria other than the criterion relating to the optimal person considered, so as to be able to obtain an evaluation matrix which contains the corresponding scores of the different optimal persons according to all the other criteria; and

b2) using said evaluation matrix and of the evolutionary game algorithm, survival of the optimal persons (I1 to I6) is evaluated according to each of the other criteria, in such a way as to obtain said survival coefficients.

15. A method for handling threats in the military field, comprising weapons assignment for handling the threats, according to which method the following successive steps are implemented:

α) information on the situation considered is retrieved;

β) this information is processed in order to deduce therefrom an engagement proposition, by first of all determining firing windows on the basis of said information, then by deducing therefrom the engagement proposition from these firing windows, said engagement proposition specifying the weapons assignment and firing instants for handling the threats; and

γ) a step of approval of the engagement proposition is provided, engagement being carried out in accordance with a engagement proposition approved in this step γ),

characterised in that in the step β the engagement proposition is determined by implementing the method specified in either claim 13 or claim 14.