Computer Work

Evolutionary Multi-objective Optimization

NSGAII

ULPGC

Master's Degree in Intelligent Systems and Numerical Applications in Engineering

Optimal Engineering Design

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Objectives:

1. To use an evolutionary multi-objective optimization software.
2. To execute different parameters in a test case: variation of population size and mutation rate should be considered at minimum.
3. To analyze and evaluate the effect of the chosen parameter set in the algorithm convergence by using the hypervolume metric.
4. To find a combination of parameter for each problem, which achieves good results (at least population size and mutation rate should be tested in a 3x3 combination set: 3 values of population size and 3 values of mutation rate, resulting in 9 parameter combinations).

Procedure:

1. In the computer laboratory, students follow the professor instructions.
2. They allow to guide step by step in a common mathematical test case.
3. Later, the students will apply these to other functions chosen by themself.
4. A report must be written with the process, results, and conclusions.

The minimum content of the report:

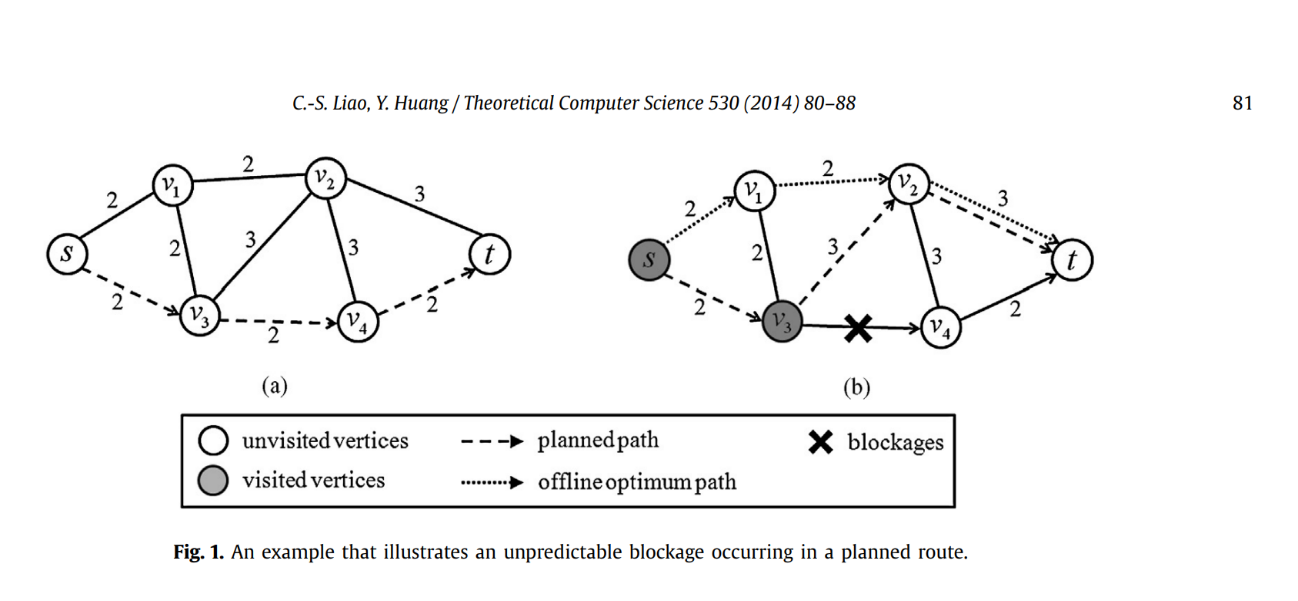
1. includes problem definition and name
2. mathematical equation of the assigned problem.
3. For each combination of parameters tested, a figure with the non-dominated final front and convergence curve of hypervolume indicator.
4. Figures where the comparison of hypervolume convergence are detailed, as well as explanation and justification of the best set of parameters tested under the perspective of balance between exploration and exploitation.
5. Same number of total numbers of fitness function evaluations should be tested in each execution (maximum value of 25.000 evaluations).

**\*Use random seed = 0.52**

Canadian Traveller Problem

Definition:

The Canadian Traveller Problem (CTP) is to find the shortest route from a source to a destination under uncertain conditions.



[*Canadian Traveller Problem example*](https://reader.elsevier.com/reader/sd/pii/S0304397514001327?token=237B006D8B72DE3EDFEF6D8B1246D35241B47C20314CAD13977E609D473B375094E99BF2F006DEF5C891618732B9EFE4&originRegion=eu-west-1&originCreation=20211208192239)

Mathematical definition:

CTP = (V, E, F, s, t, r).

(V, B) ‌‌∈ G(V, E, F).

the cost c(π, B)

of the policy is no more than r times the off-line optimal, d\_B(s, t).

Pseudocode of CPT-8:

ctp8 (double \*xreal, double \*xbin, int \*\*gene, double \*obj, double \*constr) {

    double g;

    double theta, a, b, c, d, e;

    double exp1, exp2;

    g = 1.0 + xreal[1];

    obj[0] = xreal[0];

    obj[1] = g\*(1.0 - sqrt(obj[0]/g));

    theta = 0.1\*PI;

    a = 40.0;

    b = 0.5;

    c = 1.0;

    d = 2.0;

    e = -2.0;

    exp1 = (obj[1]-e)\*cos(theta) - obj[0]\*sin(theta);

    exp2 = (obj[1]-e)\*sin(theta) + obj[0]\*cos(theta);

    exp2 = b\*PI\*pow(exp2,c);

    exp2 = fabs(sin(exp2));

    exp2 = a\*pow(exp2,d);

    constr[0] = exp1/exp2 - 1.0;

    theta = -0.05\*PI;

    a = 40.0;

    b = 2.0;

    c = 1.0;

    d = 6.0;

    e = 0.0;

    exp1 = (obj[1]-e)\*cos(theta) - obj[0]\*sin(theta);

    exp2 = (obj[1]-e)\*sin(theta) + obj[0]\*cos(theta);

    exp2 = b\*PI\*pow(exp2,c);

    exp2 = fabs(sin(exp2));

    exp2 = a\*pow(exp2,d);

    constr[1] = exp1/exp2 - 1.0;

    return;

}

#endif

1. For each combination of parameters tested, a figure with the non-dominated final front and convergence curve of hypervolume indicator.
2. Figures where the comparison of hypervolume convergence are detailed, as well as explanation and justification of the best set of parameters tested under the perspective of balance between exploration and exploitation.
3. Same number of total numbers of fitness function evaluations should be tested in each execution (maximum value of 25.000 evaluations).