CEALM (Co-Evolutionary Augmented Lagrangian Method) Version 2.0

"cealm_v20.m" is a co-evoulationary computation program for constrained optimization problems written in the MATLAB language.

This program searches for the saddle point of the augmented Lagrangian associated with the constrained optimization problem given by

$$\text{minimize} \qquad J = f(x) \qquad\qquad (1)$$

$$\text{subject to} \qquad h(x) = 0 \qquad\qquad (2)$$
$$g(x) \leq 0 \qquad\qquad (3)$$
$$a\_i \leq x\_i \leq b\_i \qquad\qquad (4)$$

where (2) is equality constraints, (3) is inequality constraints, and (4) specifies the search space. Refer to [1] or [2] to find the basic theory of the augmented Lagragian method.

CEALM Version 2.0 has the following features: (The details are referred to [4].)

1) Constraints Type

Can handle inequality constraints and equality constraints simultaneously

2) Evolution Method

Based on the evolutionary strategy described in [3]. Each individual has the parameter vector and the strategy vector (for self-adaptation). The rotation angles are not used here.

3) Violation of Search Space

The soft-wall method is used to confine the individuals within the prescribed bounds.

Note that for inequality constraints, the multipliers should be nonnegative. Refer to [5] for methods related to handling of search bounds.

4) Self Adaptation & Annealing Scheme

The self-adaptation procedure of the evolutionary strategy is used without much modification.

The annealing scheme of [4] is also implemented in Version 2.0. Set DeciGen =1 in the problem definition if this feature is not required.

5) Outputs

Screen: the best individuals during the evolution and
          the best result encountered at the end of evolution
Files: the same as above, but only when the cost is improved.

6) Constraint Tolerance

Small violations of the constraints are tolerable within user-specified bounds.

7) Termination Criteria

Simply evolves for the user-specified number of generations. No other termination criteria is used.

The program Structure of CEALM Version 2.0 is as follows:

main_v20.m   defines the optimization problem to be solved, the number of runs, etc

cealm_v20.m   solves for the saddle point

prob_***.m   specifies the file names for cost function,
                and defines various parameters for ceco_v20.m

(the file name can be anything but should be specified in main_v20.m)

obj_***.m   defines the cost function and constraints
(the file name can be anything but should be specified in prob_***.m)

The user should provide "prob_***.m" and "obj_***.m".
The number of batch runs is specified in "main_v10.m".

References:

[1] M.S.Bazaraa, H.D.Sherali, and C.M.Shetty
    Nonlinear Programming: Theory and Algorithms, 2nd ed.,
    John Wiley & Sons, 1993.

[2] P.E.Gill, W.Murray, and M.H.Wright,
    Practical Optimization,
    Academic Press, 1981.

[3] T.Ba"ck,
    Evolutionary Algorithms in Theory and Practice,
    Oxford University Press, 1996.

[4] M.J.Tahk and B.C.Sun,
"Co-evolutionary augmented Lagrangian methods for constrained optimization,"
IEEE Transactions on Evolutionary Computation, Vol.4, No.2, pp.114-124, July 2000.

[5] H.L.Choi and M.J.Tahk
"New boundary-handling techniques for evolution strategies," ICCAS 2001, Cheju
National University, Oct. 2001.

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