Deb, Kalyanmoy; **Tiwari, Santosh**

Omni-optimizer: a generic evolutionary algorithm for single and multi-objective optimization. (English) Zbl 1146.90509

Eur. J. Oper. Res. 185, No. 3, 1062-1087 (2008).

Summary: Due to the vagaries of optimization problems encountered in practice, users resort to different algorithms for solving different optimization problems. In this paper, we suggest and evaluate an optimization procedure which specializes in solving a wide variety of optimization problems. The proposed algorithm is designed as a generic multi-objective, multi-optima optimizer. Care has been taken while designing the algorithm such that it automatically degenerates to efficient algorithms for solving other simpler optimization problems, such as single-objective uni-optimal problems, single-objective multi-optima problems and multi-objective uni-optimal problems. The efficacy of the proposed algorithm in solving various problems is demonstrated on a number of test problems chosen from the literature. Because of its efficiency in handling different types of problems with equal ease, this algorithm should find increasing use in real-world optimization problems.

MSC:

90C29 Multi-objective and goal programming
90C59 Approximation methods and heuristics in mathematical programming

Keywords:

optimization; multi-objective optimization; Pareto-optimal solutions; niching; constrained optimization; evolutionary optimization

Software:

SPEA2

Full Text: DOI

References:

[1] Deb, K.; Tiwari, S., Omni-optimizer: A procedure for single and multi-objective optimization, (), 41-65

[2] Deb, K., Optimization for engineering design: algorithms and examples, (1995), Prentice-Hall New Delhi

[3] Ehrgott, M., Multicriteria optimization, (2000), Springer Berlin · Zbl 0956.90039

[4] Miettinen, K., Nonlinear multiobjective optimization, (1999), Kluwer Boston · Zbl 0949.90082

[5] Sensor, Y., Pareto optimality in multi-objective problems, Applied mathematics and optimization, 4, 1, 41-59, (1977)

[6] D. Whitley. The GENITOR algorithm and selection pressure: Why rank-based allocation of reproductive trials is best, in: Proceedings of the Third International Conference on Genetic Algorithms, 1989, pp. 116-121.

[7] L.J. Eshelman. The CHC adaptive search algorithm: How to have safe search when engaging in nontraditional genetic recombination, in: Proceedings of the Foundations of Genetic Algorithms 1 (FOGA-1), 1991, pp. 265-283.

[8] Deb, K.; Anand, A.; Joshi, D., A computationally efficient evolutionary algorithm for real-parameter optimization, Evolutionary computation journal, 10, 4, 371-395, (2002)

[9] T.T. Binh, U. Korn, MOBES: A multiobjective evolution strategy for constrained optimization problems, in: Proceedings of the Third International Conference on Genetic Algorithms (Mendel 97), 1997, pp. 176-182.

[10] Knowles, J.D.; Corne, D.W., Approximating the non-dominated front using the Pareto archived evolution strategy, Evolutionary computation journal, 8, 2, 149-172, (2000)

[11] Zitzler, E.; Laumanns, M.; Thiele, L., SPEA2: improving the strength Pareto evolutionary algorithm for multiobjective optimization, (), 95-100

[12] Srinivas, N.; Deb, K., Multi-objective function optimization using non-dominated sorting genetic algorithms, Evolutionary computation journal, 2, 3, 221-248, (1994)

[13] Deb, K.; Pratap, A.; Agarwal, S.; Meyarivan, T., A fast and elitist multiobjective genetic algorithm: NSGA-II, IEEE transactions on evolutionary computation, 6, 2, 182-197, (2002)

[14] K. Deb, M. Mohan, S. Mishra, Towards a quick computation of well-spread pareto-optimal solutions, in: Proceedings of the Second Evolutionary Multi-Criterion Optimization (EMO-03) Conference (LNCS 2632), 2003, pp. 222-236. · Zbl 1036.90525

[15] D.E. Goldberg, J. Richardson, Genetic algorithms with sharing for multimodal function optimization, in: Proceedings of the

First International Conference on Genetic Algorithms and Their Applications, 1987, pp. 41-49.

[16] A. Pétrowski, A clearing procedure as a niching method for genetic algorithms. in: Proceedings of the IEEE Third International Conference on Evolutionary Computation (ICEC'96), 1996, pp. 798-803.

[17] F. Vavak and T.C. Fogarty. Comparison of steady state and generational genetic algorithms for use in nonstationary environments, in: Proceedings of IEEE Conference on Evolutionary Computation, Nagoya, Japan, 20-22 May 1996, pp. 192-195.

[18] Goldberg, D.E., Genetic algorithms for search, optimization, and machine learning, (1989), Addison-Wesley Reading, MA · Zbl 0721.68056

[19] Holland, J.H., Adaptation in natural and artificial systems, (1975), MIT Press Ann Arbor, MI

[20] Deb, K.; Agrawal, R.B., Simulated binary crossover for continuous search space, Complex systems, 9, 2, 115-148, (1995) · Zbl 0843.68023

[21] Kita, H.; Ono, I.; Kobayashi, S., The multi-parent unimodal normal distribution crossover for real-coded genetic algorithms, (1998), Tokyo Institute of Technology Japan

[22] Deb, K., Multi-objective optimization using evolutionary algorithms, (2001), Wiley Chichester, UK · Zbl 0970.90091

[23] Cruse, T.R., Reliability-based mechanical design, (1997), Marcel Dekker New York

[24] Deb, K., An efficient constraint handling method for genetic algorithms, Computer methods in applied mechanics and engineering, 186, 2-4, 311-338, (2000) · Zbl 1028.90533

[25] Deb, K.; Goyal, M., A combined genetic adaptive search (geneas) for engineering design, Computer science and informatics, 26, 4, 30-45, (1996)

[26] Deb, K.; Mohan, M.; Mishra, S., Evaluating the \textit{&z.epsi;}-domination based multi-objective evolutionary algorithm for a quick computation of Pareto-optimal solutions, Evolutionary computation journal, 13, 4, 501-525, (2005)

[27] Deb, K.; Agrawal, S.; Pratap, A.; Meyarivan, T., A fast and elitist multi-objective genetic algorithm: NSGA-II, IEEE transactions on evolutionary computation, 6, 2, 182-197, (2002)

[28] Hoffmeister, F.; Sprave, J., Problem-independent handling of constraints by use of metric penalty functions, (), 289-294

[29] Schwefel, H.-P., Evolution and optimum seeking, (1995), Wiley New York

[30] Ho, S.-Y.; Shu, L.-S.; Chen, J.-H., Intelligent evolutionary algorithms for large parameter optimization problems, IEEE transactions on evolutionary computation, 8, 6, 522-541, (2004)

[31] K. Deb, Genetic Algorithms in Multi-modal Function Optimization, Master's thesis, University of Alabama, Tuscaloosa, AL, 1989.

[32] K. Deb, L. Thiele, M. Laumanns, and E. Zitzler, Scalable multi-objective optimization test problems, in: Proceedings of the Congress on Evolutionary Computation (CEC-2002), 2002, pp. 825-830.

[33] Zitzler, E.; Thiele, L., Multiobjective optimization using evolutionary algorithms – a comparative case study, Parallel problem solving from nature V (PPSN-V), 292-301, (1998)

[34] Wolpert, D.H.; Macready, W.G., No free lunch theorems for optimization, IEEE transactions on evolutionary computation, 1, 1, 67-82, (1977)