Global Optimization of Costly Functions using Radial Basis Functions*

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Abstract

For the global optimization of costly non-convex objective functions, Powell [1] (1998) has suggested the use of radial basis functions (RBF) to interpolate the function values so far computed. Based on this idea Gutmann [3] (1999) presented an interesting RBF algorithm.

We discuss an improved RBF algorithm, implemented in Matlab using the TOMLAB optimization environment [4]. Our results on the Dixon-Szegö test set [5] are very good compared to the results published for the DIRECT [6], EGO [7] and MCS [8] algorithms, as well as for the RBF algorithm of Gutmann. The algorithm has with great success been applied on a costly industrial problem; the design of a passenger train (optimizing the carbody and bogie masses, vibration frequencies etc.), where each function value is the result of a complicated simulation of the train ride.

References

[1] Powell, M. J. D.: 1998, 'Recent research at Cambridge on radial basis functions'. Technical Report DAMTP 1998/NA05, Department of Applied Mathematics and Theoretical Physics, University of Cambridge.

[2] Powell, M. J. D.: 1999, 'Recent Research at Cambridge on Radial Basis Functions'. In: M. D. Buhmann, M. Felten, D. Mache, and M. W. Müller (eds.): *New Developments in Approximation Theory*. Basel: Birkhäuser, pp. 215–232.

[3] Gutmann, H.-M.: 1999b, 'A radial basis function method for global optimization'. Technical Report DAMTP 1999/NA22, Department of Applied Mathematics and Theoretical Physics, University of Cambridge.

[4] Holmström, K.: 1999b, 'The TOMLAB Optimization Environment in Matlab'. *Advanced Modeling and Optimization* **1**(1), 47–69.

[5] Dixon, L. C. W. and G. P. Szegö: 1978, 'The Global Optimisation Problem: An Introduction'. In: L. Dixon and G. Szego (eds.): *Toward Global Optimization*. New York, pp. 1–15.

[6] Jones, D. R.: 1999, 'DIRECT'. *Encyclopedia of Optimization*. To be published.

[7] Jones, D. R., M. Schonlau, and W. J. Welch: 1998, 'Efficient Global Optimization of Expensive Black-Box Functions'. *Journal of Global Optimization* **13**, 455–492.

[8] Huyer, W. and A. Neumaier: 1999, 'Global Optimization by Multilevel Coordinate Search'. *Journal of Global Optimization* **14**, 331–355.

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