Application of Direct Search Methods to Parameter Estimation in Astrophysics

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Abstract

In this talk we present a new algorithm for the global minimization of a function subject to simple bounds without the use of derivatives and its application to parameter estimation problem in astrophysics. The underlying algorithm is a pattern search method, more specifically a coordinate search method, which guarantees convergence to stationary points from arbitrary starting points.

In the optional search phase of pattern search we apply a particle swarm scheme to globally explore the possible nonconvexity of the objective function. Our extensive numerical experiments showed that the resulting algorithm is highly competitive with other global optimization methods also based on function values.

We further apply the proposed algorithm to a real problem in stellar parameter estimation. The underlying optimization objective function involves the external computation of a stellar model. The objective function computation therefore is considered as a black box in the optimization context.

Keywords: Direct search, pattern search, particle swarm, derivative free optimization, global optimization, bound constrained nonlinear optimization, stellar parameter estimation.

AMS subject classifications: 90C26, 90C30, 90C56.

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