Global Mixed Integer Nonlinear Optimization by Metaheuristic Techniques

João Lauro D. Facó, Universidade Federal do Rio de Janeiro, Brazil

Mauricio G. C. Resende, AMAZON.COM, USA

Ricardo Martins de A. Silva, Universidade Federal de Pernambuco, Brazil

Abstract

Greedy Randomized Adaptive Search Procedure (GRASP), originally proposed by Feo and Resende (1989), is a multi-start metaheuristic for combinatorial problems, in which each iteration consists of two phases: construction and local search. The construction phase builds a feasible solution, whose neighborhood is investigated until a local minimum is found during the local search phase. The best overall solution is kept as the solution. Continuous GRASP (C-GRASP), proposed by Hirsh, Meneses, Pardalos, and Resende (2006) extends GRASP from the domain of discrete optimization to that of continuous global optimization to address continuous problems subject to box constraints. C-GRASP has been very successful on a wide number of applications.

Facó, Resende, and Silva (2011, 2012, 2013) proposed new versions of C-GRASP able to incorporate more general linear and nonlinear constraints. For general linear constraints we can eliminate some variables of the linearly constrained problem, and solve a reduced problem with only the box constraints by C-GRASP. General nonlinear constraints can be penalized in the objective-function with the addition of quadratic terms. Numerical experiments to find global solutions for constrained NLP continuous problems have obtained encouraging results.

Here we consider Global Mixed Integer Nonlinear Programming problems. Instead of relaxing the discrete variables, and rounding the continuous solution by branch-and-bound or cutting planes procedures that may suffer the effects of the curse of dimensionality, we propose a different approach. A new GRASP version considering both - discrete and continuous variables - is presented using an a priori choice of the discrete variables. GRASP random search and local improvement phases use simultaneously a discrete and a continuous set. We present difficult MINLP problems that have been solved with this approach.