Fundamentals for Real World Applications of Metaheuristics:
The vehicular case
Ministerio de Economía y Competitividad (Spain)
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Executive Summary

TITLE: **D4.5.1: Beating the state-of-the-art in academic benchmarks.**

PAPERS RELATED:

- F. Chicano, D. Whitley, A. M. Sutton, Efficient Identification of Improving Moves in a Ball for Pseudo-Boolean Problems, GECCO 2014, 437-444

ABSTRACT: Hill climbing algorithms are at the core of many approaches to solve optimization problems. Such algorithms usually require the complete enumeration of a neighborhood of the current solution. In the case of problems defined over binary strings of length n, we define the r-ball neighborhood as the set of solutions at Hamming distance r or less from the current solution. For $r \ll n$ this neighborhood contains $\Theta(n^r)$ solutions. In this work efficient methods are introduced to locate improving moves in the r-ball neighborhood for problems that can be written as a sum of a linear number of subfunctions depending on a bounded number of variables. NK-landscapes and MAX-kSAT are examples of these problems. We develop a hill climber based on our exploration method and we analyze its efficiency and efficacy using experiments with NKQ-landscapes instances. We can solve to optimality an instance of NKQ-landscapes with 10,000 variables in around 2 seconds using our hill climber.

GOALS:

1. Improve the existing algorithms for k-bounded pseudo-Boolean optimization problems.

CONCLUSIONS:

1. We have provided an algorithm to efficiently identify improving moves in a Hamming ball of radius r around a solution of a k-bounded pseudo-Boolean optimization problem that can be written as a sum of subfunctions.
2. The empirical results on NKQ-landscape instances show that increasing r improves the quality of the solutions found by next ascent local search.
3. We were able to solve to optimality 30 randomly generated instances of adjacent-model NKQ-landscapes with 10,000 variables in 2.1 seconds.

RELATION WITH PAST DELIVERABLES: D2.2.2.

OTHERS: W. Chen, D. Whitley, D. Hains, and A. Howe. Second order partial derivatives for NK-landscapes. In *Proceeding of GECCO*, pages 503–510, New York, NY, USA, 2013. ACM.