



Málaga, December 2014

Executive Summary

TITLE: **D4.7.1: Beating the state-of-the-art in generated instances.**

PAPERS RELATED:

- R. Tinós, D. Whitley, F. Chicano, Partition Crossover for Pseudo-Boolean Optimization, FOGA 2015 (to appear)

ABSTRACT:

A partition recombination operator is introduced for all k -bounded pseudo-Boolean functions such as NK landscapes and MAX-kSAT. Under partition crossover, the evaluation of the offspring can be directly obtained from partial evaluations of components found in the parents. Partition crossover explores the variable interaction graph of the pseudo-Boolean functions in order to partition the variables of the solution vector. Proofs are presented showing that if the differing variable assignments found in the two parents can be partitioned into q non-interacting sets, partition crossover can be used to find the best of 2^q possible offspring. This is done at $O(n)$ cost per recombination. Proofs are presented which show that parents that are locally optimal will always generate offspring that are locally optimal with respect to a (more restricted) hyperplane subspace. Empirical experiments show that parents that are locally optimal generate offspring that are locally optimal in the full search space more than 80 percent of the time. Experimental results show the efficiency of the proposed crossover when used in combination with a hybrid genetic algorithm.

GOALS:

1. Propose a new crossover operator that can explore an exponential number of solutions in linear time.

CONCLUSIONS:

1. Our theoretical results show that the offspring returned by partition crossover must be locally optimal in the hyperplane subspace in which the two parents have differing bits. In practice the offspring generated by partition crossover are also usually locally optimal in the full search space as well.
2. In the experiments presented in this paper offspring were locally optimal more than 83 percent of the time on random NK landscape problems with $N = 500$ and $K = 3$.
3. Empirical tests indicate that partition crossover yields significantly better results than 2-point crossover or Uniform Crossover on NK landscape problems when K is relatively small.

RELATION WITH PAST DELIVERABLES: D2.2.2. and D4.5.1

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.
