An Evolutionary Approach to Point-Feature Label Placement

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Abstract

This paper introduces a hybrid genetic algorithm for tagging point features on maps or other graphics with text labels.

1 THE PFLP PROBLEM

Tagging point-like graphical objects with text labels is a fundamental task in generating informational images as e.g. maps or scatterplots. The problem referred to as *point-feature label placement* (PFLP) is to assign each of a set of n labels a position around its associated point with the aim to minimize overlaps and maximize clarity. A solution to the PFLP can therefore be represented by a vector $\vec{x} = (x_1, \ldots, x_n)$ with x_i $(i = 1, \ldots, n)$ indicating the actually chosen position for label i. An objective function for evaluating such a solution may then be defined by counting the number of labels that at least partially overlap any other label or image feature and adding a suitable term for taking different position desirabilities into account. In (Christensen et al., 1995), several different techniques for approaching this NP-complete problem were empirically compared. A simulated annealing (SA) approach turned out to be most effective.

2 A HYBRID GA

In a first step, a deterministic problem reduction is applied to a given problem before the GA actually starts: Usually, some labels can safely, therefore without the danger of introducing overlaps, be assigned in advance to their most preferred positions. For other labels, some positions will under any circumstances be worse than others. These positions may be omitted from further consideration for these labels. After that an initial population is generated by using a heuristic which favors positions with no or only few potentially possible

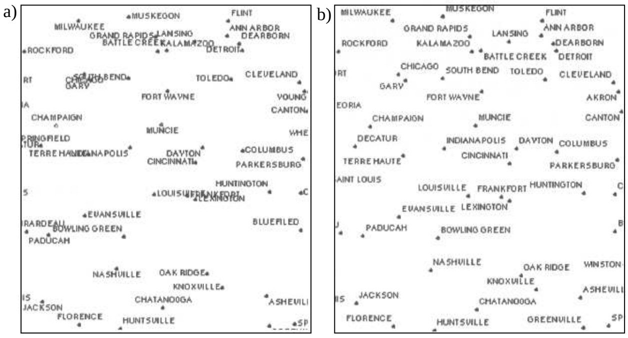

Figure 1: Part of a larger map labeled by a random method (a) and by the proposed GA (b).

overlaps. The GA itself is a traditional steady-state GA which includes a local improvement operator: For each label it is checked if it can be moved from its current position to any more desirable position where no actual conflict would occur.

3 RESULTS

The proposed GA has been empirically compared to the SA approach using several randomly generated test cases. While SA turned out to be faster for larger problems, the GA converged nearly always to better solutions, especially with fewer overlaps. See also Fig. 1 and (Raidl, 1998).

REFERENCES

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