Evolving Artificial Ant Systems to Improve Layouts of Graphical Objects

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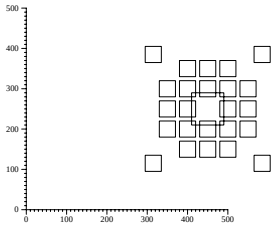
Abstract. Artificial ant systems (AAS) have been widely applied to solve many important industrial applications including network configuration or vehicle routing that involve constrained optimisation. In this paper, we explore the possible uses of AAS to handle layouts of graphical objects using constrained optimisation approach. In our evolving AAS, the stepwise movement of each individual ant naturally corresponds to the iterative adjustment of each graphical object in both x- and y-coordinates until a local minimum of a predefined objective function is reached. Up to our knowledge, this work represents the first attempt of applying AAS to improve layouts of graphical objects with simpler computation as compared to existing approaches, thus presenting new opportunities for further investigations.

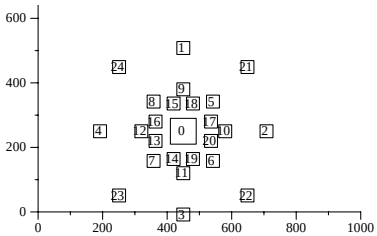
1 Background and Motivation

Artificial ant systems (AAS) [1] or their extended ant colony optimisation (ACO) techniques have recently received due attention as a powerful optimisation approach to solve many hard constrained optimisation problems including the network configuration problems [1] and traveling salesman problems (TSPs) [1]. Also widely occurring in many industrial applications, *automatic adjustment* of graphical objects represents another class of challenging constrained optimisation problems for concise information visualization. Among the many possible alignment problems between the graphical objects in any planar graph, node overlappings are essentially local conflicts that can be effectively handled by local search methods such as a modified EGENET solver [2] proposed to successfully resolve both node and edge overlappings while minimising the predefined objective function on a set of 8 arbitrarily generated test graphs. In this paper, we proposed an interesting *AAS_Layout* search framework using each artificial ant as an autonomous agent to focus on avoiding local conflicts while optimising the objective functions through their indirect communication in the global pheromone matrix.

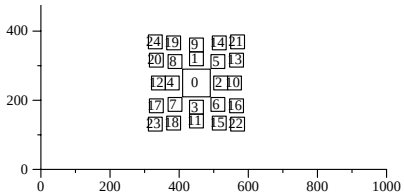
2 An Empirical Evaluation



(a) The original symmetrical graph



(b) The *AAS_Layout* solver (trial 1)



(c) The *AAS_Layout* solver (trial 2)

Fig. 1. A Symmetrical Graph.

Figure 1(a) shows a symmetrical graph of 25 nodes involving some node overlappings. Figure 1(b) shows the result in which the ant system of our proposed *AAS_Layout* algorithm biases towards the diagonal symmetries whereas Figure 1(c) is the result in which our ant system biases toward the x- and y-symmetry, thus demonstrating the flexibility of our proposal.

Possible directions for further investigation may include: trying an alternative strategy to minimize the total number of moves at each iteration whenever appropriate so as to produce more compact layouts, experimenting with different parameters such as α and β to fine-tune the performance of our proposed *AAS_Layout*, and integrating our AAS-based search proposal with other local or heuristic search methods such as the modified EGENET solver [2].

References

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2. Tam, V.: Removing Node and Edge Overlapping in Graph Layouts by A Modified EGENET Solver. in *Proceedings* of the 11th IEEE International Conference on Tools with Artificial Intelligence, Chicago IL, Nov 9-11, 1999.