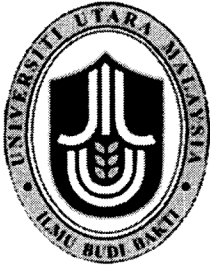


# **ANT COLONY OPTIMIZATION FOR TOURIST ROUTE**

**A thesis submitted to the Faculty of Information Technology in partial  
Fulfillment of the requirements for the degree  
Master of Science (Information Technology)  
Universiti Utara Malaysia**

**By**

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# ABSTRACT

Ant Colony Optimization is a relatively new meta-heuristic that has proven its quality and versatility on various combinatorial optimization problems such as the traveling salesman problem, the vehicle routing problem and the job shop scheduling problem. The inspiring source of ACO is the pheromone trail laying and following behavior of real ants, which use pheromones as a communication medium. In this project the ACO algorithm to routing problems in traveling cities under static and dynamic conditions. This study is divided into three parts. The first part aims to identify various connecting cities in Thailand with appropriate distances. The second part of this research involves formulating and applying the ACO algorithms to find the shortest path based on the distance calculated from source to destination cities. The ACO routing will then be applied on the constructed cities, taking into consideration different traffic conditions. The final part of the study focused on finding the shortest path and calculation of cost based on the distance traveled.

## **ACKNOWLEDGEMENT**

With great humility, I am fully aware of my ability and strength to carry out this study through. I am greatly indebted to my supervisor Prof. Dr. Ku Ruhana Ku Mahamud for her generous counsel, constructive criticisms and also had labored endlessly in supervising me. To Mr. Alaa who contribute a valuable assistance and guidance without which the study could not be completed, I am truly grateful. Hence, I would also like to record my appreciation and gratitude to my family.

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**LIST OF ABBREVIATIONS**

<b>Acronym</b>	<b>Meaning</b>
AS	Ant System
ACO	Ant Colony Optimization
ACS	Ant Colony System
TTP	Traveling Tourist Problem
TSP	Traveling Salesman Problem
SOP	Sequential Ordering Problem

# CHAPTER 1

## INTRODUCTION

Ant Colony Optimization (ACO) is a new algorithmic framework useful for solving real time problem. This project introduces ant colony system (ACS), a distributed algorithm that applies to the traveling tourist problem (TTP). In this case, the best route to visit some places at Songkhla province in Thailand using ACS. In ACS, a set of cooperating agents called ants cooperate to find good solutions to the Traveling Salesman Problem (TSP). In this project it applies to TTP. We study ACS by running experiments to find the best solution for TTP and also to get good understanding of its operation.

The natural metaphor on which ant algorithms are based is that of ant colonies. Real ants are capable of finding the shortest path from a food source to their nest without using visual cues by exploiting pheromone information. While walking, ants deposit chemical substance called pheromone on the ground, and follow, in probability, pheromone previously deposited by other ants. Usually ant prefers to follow the path with high rate of pheromone. This way exploit the past of the search to find the shortest path between two points.

Ant algorithms were inspired by the observation of real ant colonies. Ants are social insects, that is, insects that live in colonies and whose behavior is directed more to the survival of the colony as a whole than to that of a single individual component of the colony. Social insects have captured the attention of many scientists because of the high structure of level their colonies can achieve, especially when compared to the relative simplicity of the colony's individuals. An important and interesting behavior of ant colonies is their foraging behavior, and, in particular, how ants can find shortest paths between food sources and their nest. Therefore, in this research, best route to be taken by the tourist can calculate using the ACS algorithm using Visual Basic language.

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## REFERENCES

- Dorigo, M., Maniezzo, V., & Coloni, A. (1991), "The Ant System: An Autocatalytic Optimizing Process" Technical Report No. 91-016 Revised, Politecnico di Milano, Italy.
- Rigo, M., Maniezzo, V., & Coloni, A. (1996), "Ant System: Optimization by a colony of cooperating agents", IEEE Transactions on Systems, Man, and Cybernetics-Part B, 26(1), 29-41.
- Dorigo M. & Gambardella L (1997), Ant Colonies for the Traveling Salesman Problem. *BioSystems*, 43, 73-81.
- Blum C. & Roli A. (2003), "Metaheuristics in Combinatorial Optimization: Overview and Conceptual Comparisons". *ACM Computing Surveys*, Vol. 35, No. 3. pp. 268-308.
- N. Ascheuer (1995) "Hamiltonian path problems in the on-line optimization of flexible manufacturing systems", Technische Universität Berlin, Germany
- M. E. Bergen P. van Beek, T. Carchrae (2001) "Constraint-based assembly line sequencing", *Lecture Notes in Computer Science*, 2056:88-99
- Buckland, M., 2002, *AI "Techniques for Game Developers"*, Premier Press, United States of America.
- Dorigo, M., & Gambardella, L. M (1997) "Ant colonies for the traveling salesman problem" *BioSystems*, 43, 73-81
- Jones, M., 2003, "AI Application Programming", Publisher: David Pallali. Reinelt, TSPLIB—"A traveling salesman problem library", *ORSA J. Comput.* 3 (1991), 376-384.