

## Chapter 47

# An Efficient Approach for Community Detection in Complex Social Networks Based on Elephant Swarm Optimization Algorithm

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### ABSTRACT

*Complex social networks analysis is an important research trend, which basically based on community detection. Community detection is the process of dividing the complex social network into a dynamic number of clusters based on their edges connectivity. This paper presents an efficient Elephant Swarm Optimization Algorithm for community detection problem (EESO) as an optimization approach. EESO can define dynamically the number of communities within complex social network. Experimental results are proved that EESO can handle the community detection problem and define the structure of complex networks with high accuracy and quality measures of NMI and modularity over four popular benchmarks such as Zachary Karate Club, Bottlenose Dolphin, American college football and Facebook. EESO presents high promised results against eight community detection algorithms such as discrete krill herd algorithm, discrete Bat algorithm, artificial fish swarm algorithm, fast greedy, label propagation, walktrap, Multilevel and InfoMap.*

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## INTRODUCTION

Social network is a graph of nodes and edges. Social network analysis is an important research trend which helps providing many indicators. Community detection in complex social network is an urgent analysis method as results of the rapid increase in social network's data and in the number of users per network (Plantie & Crampes.2013).

Community detection is the process of defining a dynamic number of clusters within given social network and divide the network into a set of clusters based on their edges connectivity, which means edges with high density and high internal interactions will be in same cluster (Plantie & Crampes.2013). Community detection can help in dividing the social network into a set of clusters while each cluster has the same interests such as work, sport, language and education (Papadopoulos et al.2012).

Many researchers tackle this challenge of discovering insights based on using community detection in complex networks using the traditional techniques and approaches such as Spectral Clustering, Graph Partitioning, Hierarchical Clustering, Divisive Algorithm Greedy Techniques and Dynamic techniques (Malliaros & Vazirgiannis.2013; Xie et al.2013).

On the other hand other researchers tackle the problem of community detection using Bio inspired intelligence swarm algorithms to present an optimization model to solve this problem. These algorithms are inspired from nature which simulate the behavior of the herds or swarms in nature these algorithms are continuous in nature so redesigning these algorithms to fit in community detection is an mandatory step (Hassanien & Emary. 2016).

Swarms are used to solve community detection problem with high accuracy results such as an artificial fish swarm model (Hassan et al.2015), Bat optimization model (Hassan et al.2015), krill herd model (AKHSO) (Ahmed et al.2015) and Anti lion model (Babers et al., 2015; Ahmed et al., 2016).

Contributions of EESO are presenting a new community detection algorithm based on Elephant swarm optimization algorithm, Converting basic Elephant swarm with its continuous feature into a discrete by using The locus-based adjacency scheme, improving basic elephant swarm optimization and its parameters and comparing our results with eight popular algorithms over four datasets as benchmarks.

The rest of the paper is organized as follows: Section 2 states Community detection problem definition. Section 3 states Elephant swarm algorithm. Section 4 states the proposed algorithm. Section 5 presents experimental results. Section 6 states a comparison analysis, Convergence curve is stated in Section 7 the conclusion and future works of this paper is states in Section 8.

## COMMUNITY DETECTION PROBLEM

The proposed problem is to define dynamically the number of communities within complex social network graph (G), which contains a set of Nodes (N) and edges(E), which illustrated in equation.1, that fulfill the quality function F(S), which illustrated in equation 2 (Ahmed et al.2015). There are a lot of challenges to apply community detection process in social network data such as heterogeneity and evaluation of this complex networks.

$$G = \{N, E\} \quad (1)$$

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