A Survey on Analysis Terrorist Networks with Complex Networks

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Abstract:

Many researchers, after the terrorist attacks in 2001, have been looked for understand the functions and structures of terrorist networks. This paper analyzes various techniques and methods proposed in this area and discuss how the complex network helps us to identify the important nodes in the terrorism network. By use the standard social network analysis (SNA) measures such as (degree, betweenness, closeness) centrality, and apply techniques from different field such as game theory, Fuzzy Analytic Network method. Furthermore, a little of research are focus on the how we can predict the terrorist threat, which is hard for uncertain or hidden information. After analyzing the techniques and show the challenges in the terrorist network a proposal solution is made in conclusion Index Terms— Terrorist Network, Centrality measures, covered group, Social network analysis (SNA)

I. INTRODUCTION

he science of complex network is a young and active area of scientific research trying to understanding the complex real world around us such asAirline router, Internet and social networks. Since the September 2001 terrorist attacks, scientists and the policy community have focused on the ways in which the science of complex systems might be applied towards reducing the risk or consequences of future attacks. The fear of

terrorism is still filled in many people's minds. According to NIC[1], the number of deaths due to terroristattacks worldwide between 2006 and 2013 declined by about 2,500 killed people but increased from 2012 to 2013 with a number of 6,000 killed people as shown in Figure 1. This kind of information inspire the research to looking for efficient measures to know the leaders, funds, bomb experts, martial members, and so on to defeating terrorist group. AS J. Doyne Farmer, Santa Fe Institue said, "The best method to control something is to understand how it work". As the science and technology have been improved, there are many measures and methods help to identify the significant nodes in covered network and understand the topology of network. However, studies of terrorist network structure have generated little results. This is due to the difficulty in collecting and accessing reliable data about covered group and the lack of advanced network analysis methodologies in the field of hiding or uncertain information [2]. Analyzing the network after an attack is relatively easy for examination purpose while map the covered network to prevent criminal activity is much difficult task. In this paper a brief working of current centrality measures and algorithms that identify the terrorists with three basic categories as what field the measures belong to: Social Network Analysis measures, graph theory and data mining and Game theory.

The remainder of this paper is organized as follows. Section 2 provides the challenges in terrorist group. Section 3 provides Social Network Analysis measures and highlights the most common metrics. Section 4 provides implement measure from graph theory and data mining field. Section 5 discusses the general review of all measures and finally, Section 6 provides proposed and conclusion.

II. CHALLENGES IN THE TERRORIST NETWORK

In this section mention in brief the most the challenges in terrorist group. [3] [4]

1) Social network graphs describing covert groups may be incomplete due to missing actors (vertices) and links (edges) that investigators may fail to uncover.

2) The difficulty in deciding who to include and who not to include is not a problem in legitimate networks like families and organizations. But in terrorist networks this may be a problem due to the secrecy maintained by the entire network of people.

3) Terrorist networks are not static as new members are added to strengthen the group and members are removed (killed, captured, compromised) which shrinks the group size. Most organizational networks are also dynamic but this is hardly the case with families group.

4) Relationships between members belonging to a terrorist network and those not belonging to terrorist networks are rare and infrequent. Terrorists seldom make friends outside the trusted circle because eliminating boundary-spanning ties reduces the visibility into the network, and chances of leaks out of the network.

III. SOCIAL NETWORK ANALYSIS MEASURES

Social network analysis (SNA) is used in sociology research to analyze patterns of relationships and interactions between social actors in order to discover an underlying social structure. A number of quantitative SNA methods have been employed to study organizational behavior, inter-organizational, and citation analysis.

In SNA studies, a network is usually represented as a graph, which contains a number of nodes (network members) connected by links (relationships).

can be used to identify key members and interaction pattern between sub-groups in terrorist networks. There are

many important centrality measures have been proposed by Freeman [5] and others to rank nodes in networks.

1) Degree Centrality

Degree centrality is the simply and important centrality measure. It is the number of direct relationships that a node has. Degree centrality can infer us to the leader of community For example, Osama bin Laden, the leader of the central member in the Global Salafi Jihad (GSJ) group, had 72 links to other terrorists and ranked the second in degree [2]. Degree Centrality of node i can be defined as Di = Σ(∈* A'(Where Aij is the element in the adjacency matrix A at ijth position.

2) Betweenness Centrality Betweenness is measure that is derived from the concept of counting the shortest paths between individuals in a network. The high Betweenness node is very important like bridge between two building, cities or groups. Let n '-. = 1if node i belong to path from s to t and g -. the number of shortest paths from node s to t. The betweenness define as $C2i$ = $3n$ '-.g -. -.

For example, Members with high betweenness, hold special interest for terrorist experts because they are usually the contact person between several terrorist groups and play important roles in arrange terrorist attacks.

3) Closeness Centrality It measures the mean distance from vertex to other vertices. In simple word, if we want to know how far a node from its neighbor. It defined as $C4(i)$ = 7 8 ' = 9 Σ; :'(where n number of nodes, dij the distance between nodes i,j In [2] they take in account the low closeness nodes, which are usually called outliers in SNA. Outliers in illegal networks could be the true leaders. They appear to be outliers because they often direct the whole network from behind the scene, which prevents authorities from getting enough intelligence on them.

The betweenness and closeness centrality can be better than degree centrality to identify influential nodes, but are

incapable to be applied in large-scale networks due to the computational complexity [6]. Kas, propose incremental algorithm to calculate the betweenness/closeness centrality faster and accurate in large and dynamic network. As in terrorist network, the member could appear in a social network for period of time then disappear to become hidden from government or for other reasons. That mean terrorist is kind of dynamic network and we can apply the Incremental algorithm to calculate the betweenness and closeness centrality in the terrorist network [7][8]. The simple idea of this algorithm is updates the solution to a problem after an incremental change is made on its input. In other word, start with the old output of the algorithm and modify only the affected values (e.g node insertions / deletions/modifications) are reflected on the output (centrality) values and finally with faster computation.

4) PageRank

PageRank originally designed to calculate the importance of Web pages based on the Web link structure and is used in the commercial search engine Google to rank the search results.

However, PageRank [9] is a measure for computing the relative importance and ranking the nodes in the social network. Using PageRank in terrorist network analysis overall importance of a person can be determined based on its position in the network.

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