Scientists develop a novel algorithm inspired by bee colonies to help dismantling criminal social networks

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Credit: University of Granada

Researchers from the University of Granada (UGR) have designed an algorithm, inspired by the intelligent and social behavior of bee colonies,

which allows law enforcement to attack and dismantle any type of social network that poses a threat, whether physical or virtual, such as social networks linked to organized crime and jihadist terrorism.

The possible applications of this new bio-inspired algorithm, which helps to make optimal decisions in order to dismantle any type of social network, are many and varied: from dismantling a criminal network to facilitating the design of vaccination strategies capable of containing the spread of a pandemic.

The tool designed by the UGR researchers automatically detects and identifies the most dangerous actors or nodes within a given social network and the density of the interconnected relationships between them, which may help law enforcement authorities make their decisions and act in the most efficient way possible.

As explained by one of the authors of this paper, Manuel Lozano Márquez, from the Department of Computer Science and Artificial Intelligence at the UGR, "Bees form fairly well organized societies, in which each member has a specific role. There are three main types: scout bees, which are looking for food sources; worker bees, who collect food; and supervisor bees, who wait in the colony."

Data exchange and communication processes are established between those three roles, which makes the overall performance of the colony very profitable. The UGR scientists have simulated this behavior using in silico bees in order to find effective and efficient strategies to dismantle networks. The results of the experiments indicate that the proposed technique significantly improves, from a statistical point of view, the classic strategy used for attacking and dismantling social networks.

Social networks

Many complex interaction systems linked to nature and related to mankind are structured in a complex network—that is, they are made up of a series of interrelated actors. Social networks are a very recent example of this. Some networks are pernicious because of their potential to cause harm to people, critical infrastructures and economic interests.

The classic (and also the most natural and intuitive) method for dismantling a network is to identify its main actors and take action on them. However, this strategy does not ensure that the resulting network is totally devoid of organizational and reconstructive power, and it may continue to cause harm.

"In order to find the most effective way of dismantling a network, it is necessary to develop and put into action an optimization process that analyzes a multitude of situations and selects the best option in the shortest time possible. It's similar to what a chess program does when identifying, predicting and checking the possible steps or paths that may occur in a game of chess from a given moment and movement," says Humberto Trujillo Mendoza from the Department of Methodology of Behavioral Sciences at the UGR and one of the authors of the paper.

As the authors explain, "The subtlety with which groups or colonies of relatively simple living beings (ants, termites, bees, etc.) are able to solve vital problems to survive is a proof of the effectiveness of evolution." By means of certain interrelationships among the members of a colony, a collective behavior emerges from that colony, and it allows them to efficiently react to problematic environmental situations. That task, applied by the UGR to the field of artificial intelligence, would be impossible to carry out by individual members of the colony.

At present, this research group is working on the development of other algorithms similar to the one described. This time, they are doing so to determine the nodes of the social network which certain "infiltrators"

must connect to in order to increase the quantity and quality of the information gathered to improve the knowledge of the relations between the other actors, thus optimizing the dismantling of the network.

More information: Manuel Lozano et al. Optimizing network attacks by artificial bee colony, *Information Sciences* (2017). DOI: 10.1016/j.ins.2016.10.014