Nature-inspired AI algorithms offer new solutions to complex problems

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Nature has provided inspiration for many innovations. In recent years, the development of algorithms that emulate the problem-solving ability of the natural world have come to the fore. Such algorithms, computer

programs that are modeled on various natural behaviors, are known collectively as nature-inspired algorithms.

They are designed by studying the dynamics of a natural or social system, such as those observed in ants and bees or the movements and skills of bats and birds. There are several classes defined by the behavior on which they are modeled, including swarm intelligence, biological systems, and physical or chemical processes.

Swarm intelligence is a particularly useful part of nature-inspired algorithms. It is derived from the collective behavior of groups of animals, such as flocks of birds or schools of fish. The principle behind these algorithms is the concept of self-optimization, a hallmark of natural systems that efficiently manage resources and adapt to changing environments to solve seemingly complex problems. By transferring these natural skills into an algorithm, researchers are finding ways to develop self-optimizing systems for some of the problems we face.

In a paper published in the *International Journal of Advanced Intelligence Paradigms*, S. Thanga Revathi of the Misrimal Navajee Munoth Jain Engineering College in Chennai and N. Ramaraj of Vignan University in Guntur, India, explain how nature-inspired algorithms can give us an efficient and adaptable way to approach difficult and perhaps otherwise intractable problems.

They cite some of the most notable, such as the ant colony optimization (ACO), particle swarm optimization (PSO), cuckoo search, and the bat algorithm. Each of these algorithms uses characteristics of natural collective behavior to converge on a solution to a problem.

For instance, within a bird flock, each bird follows simple rules without any single leader that then gives rise to the complex system that is a starling murmuration. Flocking behavior like a murmuration is

commonly a collective predator avoidance technique. The birds' movements are influenced by their closest neighbors' organization. Avoiding collisions, matching velocities, and maintaining proximity to the group are what lead to this coordinated and cohesive movement of the flock.

The practical applications of swarm-based algorithms span a wide array of fields. In biomedicine, for example, they can be used in diagnosis, genetics, and protein structure prediction. Other algorithms can be used to manage networks, classify data, and manage queuing systems.

The review suggests that we have only just begun to develop nature-inspired systems and that there is great potential to model many different systems in the natural world for addressing a wide range of the problems facing humanity.

More information: S. Thanga Revathi et al, A brief study about nature inspired optimisation algorithms, *International Journal of Advanced Intelligence Paradigms* (2024). DOI: 10.1504/IJAIP.2024.139952

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