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SWARM INTELLIGENCE COLLISION AVOIDANCE METHOD FOR LEO COMMUNICATION SATELLITES

Abstract

Global positioning systems (GPS), weather forecasts, and communication networks are just a few of the vital services that Low Earth Orbit (LEO) satellite constellations offer. But, as more satellites enter orbit, the likelihood of collisions—which have the potential to be disastrous—increases. This abstract suggests a brand-new, never-before-seen approach to LEO satellite collision avoidance.

The suggested collision avoidance technique is based on swarm intelligence, a developing field of study that takes cues from social insects including ants, bees, and termites. These insects can cooperate, communicate decentralizedly, and follow straightforward principles to complete challenging tasks. Collision avoidance can be accomplished for LEO satellite constellations in a decentralized and effective manner by using these ideas.

Each satellite would include a tiny onboard computer, camera, and communication module according to the suggested method. The satellite's internal computer would continuously examine the video stream and the satellite's position in relation to other neighboring satellites. The communication module would be used by the onboard computer to notify nearby satellites of the potential risk if it detects a probable collision. In order to prevent a collision, the other satellites would then modify their course.

The suggested approach would enable the satellites to cooperate in order to prevent collisions without requiring centralized management or communication. This would offer a high level of redundancy and fault tolerance, strengthening and strengthening the system. Also, the system's decentralized design would enable the addition or removal of satellites without requiring major reconfiguration, lowering maintenance and operating expenses.

The proposed approach to avoiding collisions provides a number of benefits over more conventional ones. It reduces the possibility of a single point of failure firstly by being decentralized and fault-tolerant. Second, it is effective, enabling satellites to cooperate in order to prevent collisions. Third, because it is scalable, big constellations can use it.

In conclusion, the suggested swarm intelligence-based collision avoidance technique has the potential to fundamentally alter how we think about collision avoidance in LEO satellite constellations. The suggested approach has the potential to increase the effectiveness and dependability of satellite constellations while lowering maintenance and operational costs, even though there are still a number of issues that need to be resolved, such as the creation of reliable onboard computers and communication modules. Additionally, the suggested technique might be used in other industries like robotics and autonomous vehicles where decentralized coordination and communication are crucial.