

MAJOR LEAP | Safer, more efficient flights for massive UAV groups **IIT-Indore develops algorithm for safer, more efficient UAV swarms**

Our Staff Reporter

INDORE

In a major leap for autonomous aerial technology, researchers from the Indian Institute of Technology-Indore and Institut Mines-Télécom (IMT), France, have unveiled a novel collision-avoidance algorithm that promises to make large-scale Unmanned Aerial Vehicle (UAV) swarm operations safer, smoother and faster.

The joint project, led by Prof Kapil Ahuja and Amit Raj of IIT-Indore's Math of Data Science and Simulation

(MODSS) Lab, along with Prof Yann Busnel of IMT, tackles one of the biggest challenges in UAV swarm management—avoiding mid-air collisions without sacrificing operational efficiency.

One existing method involves changing the UAVs' flight paths. While effective for small groups, it becomes inefficient for large swarms—creating overly complex routes and even infinite loops in some cases. Another common method involves adjusting UAV start times by grouping them into collision-free "batches," but this slows down swarm de-

ployment when too many batches are needed.

The new algorithm combines the strengths of both approaches while eliminating their weaknesses. Using a UAV simulator that tracks positions at regular intervals (such as every second or every 0.1 second), the researchers developed a trajectory adjustment technique.

When two UAVs are predicted to collide, the position of one UAV is slightly shifted. This shift gradually increases before the potential collision, peaks exactly at the predicted collision point and then decreases

smoothly afterwards.

This approach was then integrated with the batching method, resulting in smooth, simple and finite route changes and 50% reduction in the number of required batches.

IIT-Indore director Prof Suhas Joshi said, "This achievement reflects IIT Indore's commitment to developing technology that addresses real-world challenges through deep collaboration. The partnership with Institut Mines-Télécom demonstrates how global research synergies can produce impactful solutions that set new benchmarks in UAV tech-

nology."

Ahuja commented, "This innovation ensures safer and more efficient flights for massive UAV swarms. By reducing complexity and avoiding unnecessary delays, it opens up possibilities for faster, more reliable UAV operations in diverse applications—from disaster relief and surveillance to agriculture and logistics."

The team believes this algorithm will significantly enhance UAV swarm performance, paving the way for advanced autonomous aerial systems capable of safe, coordinated, and large-scale operations.