The article titled "Robust Distributed Model Predictive Control for Satellite Cluster Reconfiguration with Collision Avoidance" was published in "Aerospace Science and Technology 130" in the year 2022​. This paper addresses the challenge of reconfiguring a satellite cluster while ensuring collision avoidance. The main focus is on addressing uncertain disturbances. To tackle this, the authors design a tube-based auxiliary controller, which enhances the robustness of the actual satellite cluster system. Additionally, they propose a distributed model predictive controller (DMPC) tailored for the nominal system, incorporating thrust constraints. The DMPC design includes terminal constraints and a terminal control law based on the velocity obstacle concept to ensure collision avoidance. The paper also introduces an optimal allocation strategy for target points, utilizing the Hungarian algorithm, to reduce fuel consumption and collision actions. The effectiveness and advantages of these proposed methods are demonstrated through numerical simulations.

The article titled "Satellite Cluster Formation Reconfiguration Based on the Bifurcating Potential Field" was published in Aerospace, Volume 9, Issue 137, in March 2022​. This research addresses the challenge of reconfiguring satellite cluster formations, an area that has gained significant attention in recent years. Traditional centralized control methods for satellite clusters face difficulties, particularly in terms of high fuel consumption. To address these challenges, this study proposes a novel mathematical characterization method for satellite clusters, as well as a control method based on bifurcating potential fields. This method aims to enable dynamic migration and rapid reconfiguration of satellite cluster formations. The study introduces a "five-element characterization method" to represent the characteristics and internal correlations of orbiting satellite clusters. Through simulations with a cluster of 50 satellites, the research demonstrates the feasibility and effectiveness of the proposed formation control algorithm, showing that various formation topologies can be achieved by simply adjusting the bifurcation parameter and configuration adjustment parameters. These five elements provide an intuitive and effective means to reflect the operational state of the satellite cluster​. The article titled "Autonomous Obstacle Avoidance Strategies in the Mission of Large Space Debris Removal Using Potential Function" was published in Advances in Space Research, Volume 72, in 2023

The paper focuses on developing autonomous collision avoidance strategies for spacecraft (Servicers) involved in large space debris removal missions. With the increasing problem of space debris, the need for effective debris removal operations has become crucial. These operations often face the challenge of potential collisions with small objects orbiting around the target debris. To address this issue, the paper introduces improved potential function-based strategies that enable the Servicer to rendezvous with large debris while avoiding obstacles along its trajectory. The study devises a repulsive potential for static obstacles based on their relative position vectors and, considering the necessity to avoid dynamic obstacles, incorporates the relative velocity vector between the Servicer and dynamic obstacles to design a repulsive potential for these dynamic obstacles. Additionally, a corresponding control law is derived to guide the Servicer towards the large debris. The effectiveness and stability of these obstacle avoidance strategies are then validated through numerical simulations. These strategies represent a significant advancement in ensuring safe and efficient space debris removal operations.

The paper titled "Disturbance Observer-Based Performance Guaranteed Fault-Tolerant Control for Multi-Spacecraft Formation Reconfiguration with Collision Avoidance" was published in Aerospace Science and Technology, Volume 133, in 2023​.The study addresses the challenge of fault-tolerant control for formation reconfiguration with collision avoidance in multi-spacecraft systems, considering space perturbations and thruster faults. The paper introduces a novel nonlinear iterative learning disturbance observer (NILDO) designed to accurately reconstruct synthesized disturbances, regardless of their time-variance. Additionally, an exponential artificial potential function is developed for collision avoidance between spacecraft, featuring a simple structure and low computational requirements. The paper also explores a nonsingular terminal sliding mode fault-tolerant control method to achieve fault-tolerant formation reconfiguration with collision avoidance capability and robust performance. The effectiveness and superiority of these proposed approaches are validated through numerical simulations and comparisons. The main innovation lies in the integration of NILDO for disturbance reconstruction and the implementation of an exponential artificial potential function and terminal sliding mode approach for robust, fault-tolerant collision avoidance.

The paper titled "Dynamic Event-Triggered Attitude Synchronization of Multi-Spacecraft Formation via a Learning Neural Network Control Approach" was published in Aerospace Science and Technology, Volume 142, in 2023​.The study addresses robust attitude synchronization in a multi-spacecraft formation system, particularly under constraints like limited communication, space disturbances, modeling uncertainties, and actuator faults. To manage limited inter-spacecraft communication, the paper introduces a dynamic event-triggered mechanism that dynamically adjusts the communication trigger threshold to reduce frequency. Furthermore, an innovative event-based distributed self-learning neural-network control (SLN2C) law is developed to ensure robust attitude synchronization during the formation of multi-spacecraft. This SLN2C method utilizes a learning radial basis function neural network (RBFNN) model, which approximates and compensates for lumped disturbances online. An iterative learning algorithm with variable learning intensity is used to update the weight matrix of the RBFNN model, offering advantages over traditional fixed learning intensity by reducing initial oscillation and weakening the saturation response. The effectiveness and superiority of this novel event-based spacecraft attitude synchronization control method are demonstrated through numerical simulations and comparisons

​The paper titled "Finite-time Distributed Hierarchical Control for Satellite Cluster with Collision Avoidance" was published in Aerospace Science and Technology, Volume 114, in 2021. The paper introduces a novel distributed hierarchical control method for small satellites, aimed at addressing the challenges posed by multiple disturbances and input constraints in satellite clusters. This method combines formation flying and satellite clustering. A key component of this method is the development of a finite-time convergent extended state observer (FTCESO), designed to estimate external disturbances with high precision. Alongside this, a non-singular fast terminal sliding mode controller (NFTSMC) is proposed to maintain the specific configuration of leader satellites, ensuring finite-time convergence. Additionally, the paper proposes an improved artificial potential field method equipped with collision avoidance and damping characteristics for follower satellites. This enables follower satellites to maintain a collision-avoidance relative distance from their corresponding leader satellites within the desired communication range. The effectiveness of this proposed method is demonstrated through numerical simulations. The main innovation lies in the integration of FTCESO and NFTSMC for managing disturbances and maintaining configurations, combined with the novel use of an improved artificial potential field method for effective collision avoidance.

The paper titled "Trajectory Planning for Satellite Cluster Reconfigurations with Sequential Convex Programming Method" was published in Aerospace Science and Technology, Volume 136, in 2023​. This research presents trajectory planning algorithms for large-scale satellite clusters, employing sequential convex programming (SCP). The algorithms are designed to address both fuel consumption and collision avoidance. Initially, the trajectory planning problem is characterized as a nonconvex optimal control problem with nonlinear dynamics and nonconvex path constraints. The original nonlinear continuous optimal control problem is then converted into a discrete convex optimization subproblem using linearization and discretization methods. This approach includes a collision avoidance strategy between discrete points and obstacle avoidance constraints to ensure that the trajectories are collision-free. The paper introduces both coupled and decoupled SCP methods to generate collision-free and fuel-efficient trajectories rapidly. Comparative numerical simulations demonstrate significant performance improvements in computational efficiency (94 to 99 percent) over the pseudo-spectral method, particularly as the number of satellites increases. The main innovation of this paper lies in the application of sequential convex programming to satellite trajectory planning, enabling efficient management of complex, large-scale satellite clusters with enhanced computational efficiency.