Unmanned Aerial Vehicles (UAVs), commonly known as drones, have recently been applied in choreographed light shows and thus evoked a new boom in technology. In 2016, Intel® used a cluster of its Shooting Star™ drones that were controlled by only one pilot and a single laptop to perform an aerial light show, resulting in a twinkling digital galaxy floating above the skyline.

Yet Intel is not the only company interested in aerial shows using drones since this newly formed technology has been brought under the spotlight and has remained to be a heated topic.

Other related researches and finding also focused on the control and orientation of drones in application.

In response to the Mayor’s ask of an outdoor aerial light show using drones, we carefully investigate the idea and would like to present our mathematical model, conclusions and recommendations for the aerial light show. In brief, we address the problem of optimizing the flight paths for each drone through mapping the locus function with three-dimensional system of coordinates, taking the number of drones required, safety concerns, launch area required and air space required into consideration.

We formulate a optimization model to account for the optimal flight path for each drone in order to form the shape of our three-dimensional design of display——a Ferris wheel, a dragon and a lotus——a mixture of both static and dynamic images. Based on the historical data from all the aerial light shows using drones that have already taken place so far, we determine the initial conditions, prerequisites and several basic parameters of drones for our model. To solve the model, the shortest path and its length of every two nodes in the incomplete undirected graph are calculated with Floyd algorithm. In search of the optimal model, we run through the particular path for each drone and group those paths that share similar characteristics to minimize the number of functions controlling the drones using clustering analysis. To ground this model in reality, we animate the image and the whole display process through computer simulation to adjust and update colliding paths. More detailed speaking, we utilize the overfitting analysis to optimize the locus into a smooth curve. Additionally, we uses the Bessel function t0 fit the speed of the drones, making the transition between each image more vivid.

We show that this strategy is not optimal but can be improved by optimizing the coordinates and functions of the flight path for each drone. If the Mayor were to adopt this model and strategy for the aerial light show on the annual festival, the cost would be approximately......We modify the model to reflect the flight paths and generalize the model to other fields including but not limited to the combat drone operation as well as control and orientation system. We conclude with a series of recommendations for how best to design and distribute the particular path for each drone. The simulation examples validate the feasibility of our strategy.

Our suggested solution, which is easy to implement, includes a detailed aerial display program and flight paths for each drone. We firmly believe that our algorithm is broad and flexible enough to accommodate various local conditions, safety concerns and other unexpected incidents. Since our model is based on the control and orientation of UAVs, our strategy may also contribute to other technologies related to drones.