Hello, my name is Junyan Peng and my senior research project on a basic level is asking when spacecraft should be launched.

Motivation for this project stems from space travel being a human interest both for resources, such as minerals on bodies like the Moon, and for discovery, as humans have throughout history journeyed into the unknown from the highest peak to the deepest trench.

Determining when spacecraft should launch, however, is complicated as the planetary destination is continuously moving while the spacecraft travels there. In addition, the rate at which the spacecraft moves is small relative to the long distance it will have to travel. Furthermore, mathematical expressions like definite integrals quantifying the movement of the planet and the rocket are complicated as the acceleration of the body is dependent on the position of the body which is subsequently dependent on the acceleration. This makes solving this problem difficult by hand.

However, time-step algorithms which change the position of the bodies in steps instead of the one big calculation of a definite integral are efficient for computers to run due to a computer’s ability to quickly perform calculations even for a great number of steps which allows for higher accuracy.

By programming time-step algorithms and applying it to spacecraft and planets over a time period, a date and angle for a launch can be accurately and efficiently calculated.