

SCUDEM IV 2019

Problem B: Movement Of An Object In Microgravity Environments

In February 2019 a Japanese probe made contact with a small asteroid, Ryugu [1]. The team overseeing the program had to overcome a number of technical challenges. For this question we focus on the issues associated with a low gravity environment. The team had to land a probe gently enough so that it does not bounce and move too far away from a designated landing position. The next problem is moving the probe to a new position using a minimal amount of energy and also minimizing how far the probe bounces on the surface of the asteroid.

You have been asked to provide guidance in helping find a new asteroid on which to land a probe. The goal is to determine the range of dimensions for the smallest possible asteroids which can be used to land a probe. (Keep in mind that asteroids can have high aspect ratios and are generally not round.) Your team should develop a method to land a small probe on the asteroid and the final position of the probe after coming to rest should be as close as possible to a predetermined landing point. At the same time the amount of bouncing should be as small as possible to avoid damaging the probe. You should also develop a way to move the probe to a predetermined position using a spring that will allow the probe to hop in a given direction without using a device that generates thrust. The analysis you provide should include a detailed description of the mathematical models you develop to describe the movement of the probe in these different conditions.

The surface of the asteroid is assumed to be quite rugged, and the probe may have to jump into a ravine or along the side of a steep cliff. You should provide guidance concerning the limits of moving the probe using a minimal number of jumps under a wide variety of situations. Your analysis should include a description of the possible limits to what area can be explored and the description should include guidance on choosing an asteroid with respect to the possible dimensions.

References

[1] Wall, Mike, "Japanese Spacecraft Successfully Snags Sample of Asteroid Ryugu," space.com, 22 February 2019, <https://www.space.com/japanese-asteroid-probe-lands-ryugu.html> . Accessed June 2019.