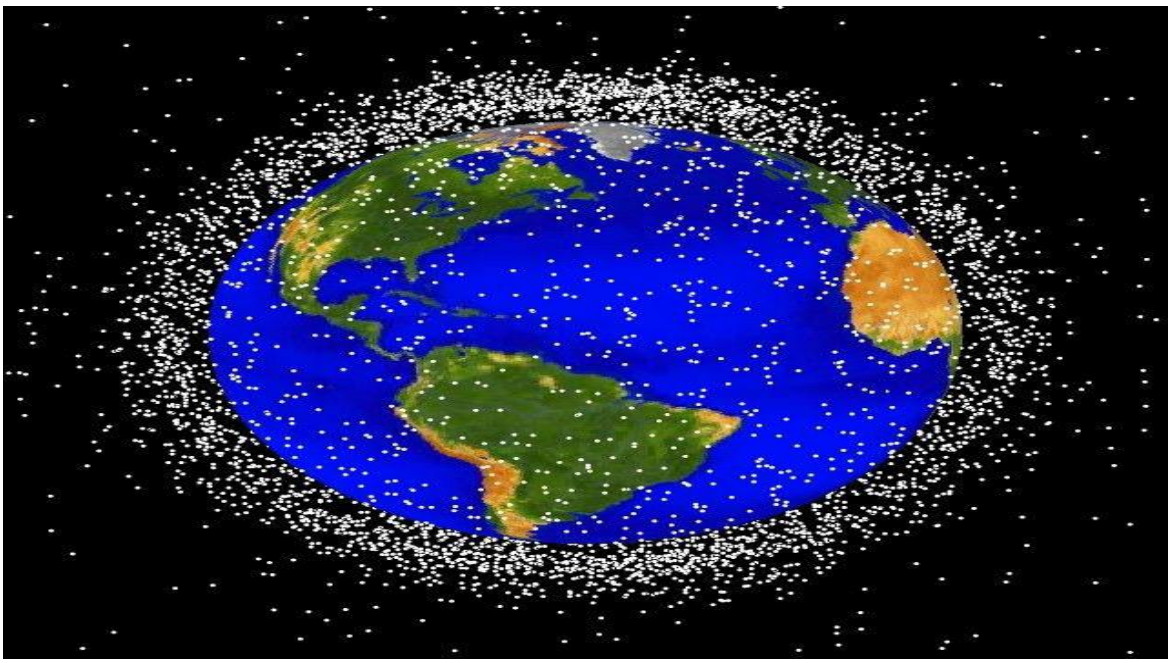
Cheapest solution to limit space junk

Overcoming the problem of space junk is very important as it can be responsible for loss of millions of money. As per the current scenario, when the satellite work is completed, engineers use its last bit of fuel to slow it down so it will fall out of orbit and burn up in the atmosphere. But this can lead to problems like global warming, acid rain, pollution etc. I have an alternative i.e. periapsis burn. Using the small amount of fuel, we can perform periapsis burn phenomena. The periapsis burn means that the most energy-efficient method for a spacecraft to burn its fuel at the lowest possible orbital periapsis, when its orbital velocity (and so, its kinetic energy) is greatest. Burning fuel at perigee can give me trajectory change and velocity gain. After six periapsis burn, the velocity will reach to 11.2 km/s (Escape velocity). Thus, it will leave Earth's gravitational sphere of influence and get lost in space. We can adopt this method as there are no chances of ecological crisis and this is one of the cheapest ways to deal with the problem of space junk. However, this idea would not be able to remove space junk completely (as we have lost communication with nearly 3000 satellites), but through this idea, the number will not exceed further.

Table of contents

INTRODUCTION

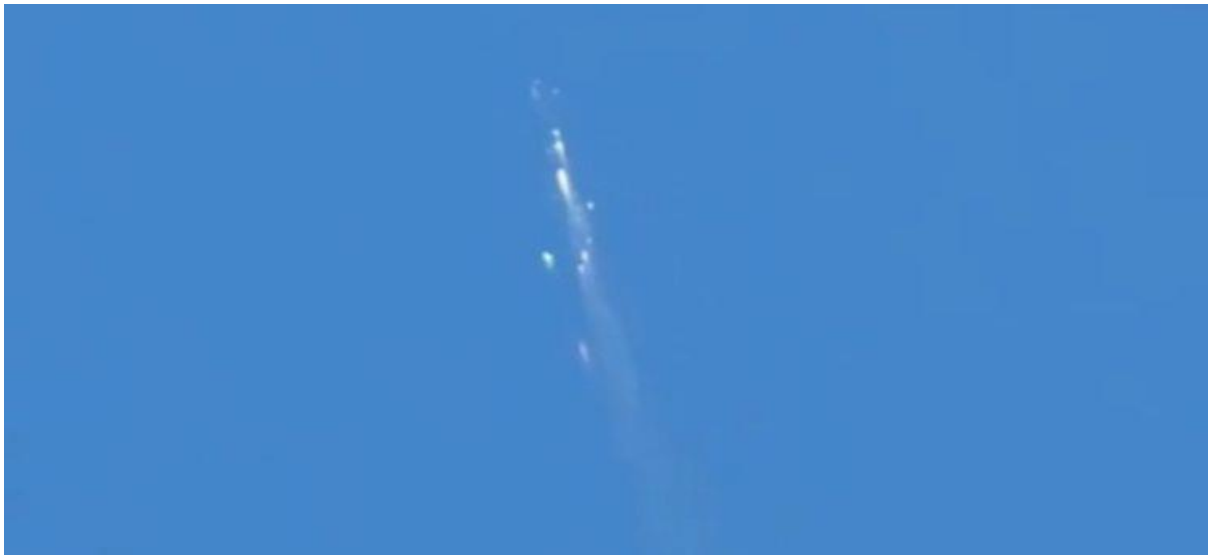
Many pieces of debris or “space junk”, are tracked as they orbit the Earth. This can be very hazardous. Revolving Debris of damaged satellites can collide with working satellites which can lead to loss of millions of money. In case, if astronauts are working on any satellite and if suddenly debris collides with that satellite, it can lead to loss of many valuable lives. The density of the junk may become so great that it could hinder our ability to use weather satellites, and hence to monitor weather changes caused by our own ground-based pollution. Thus to overcome this space junk is necessary.



Where do old satellites go when they die?

For the closer old (dead) satellites, engineers will use its last bit of fuel to slow it down so it will fall out of orbit and burn up in the atmosphere. **I totally disagree** with this because of following three reasons:

i. When dead satellites burn in the atmosphere, they leave behind chemicals that could damage the ozone layer.
ii. This can lead to pollution.
iii. It can be a major cause of acid rain, global warming etc.



A vintage NASA satellite burned up as it re-entered the Earth's atmosphere after 56 years.

My idea to overcome the problem of space junk is periapsis burn. Let us know more about it in detail.

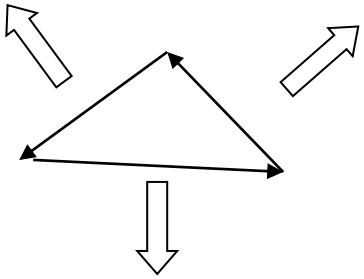
METHODOLOGY

How periapsis burn can be used in overcoming the problem of space junk?

All satellites which will launch in near future should have little extra fuel. And when the satellite's work is completed, we can use this fuel. When the satellite is at perigee, we can burn this fuel for some time. This will increase the velocity of the satellite, thus it leads to fractional change in kinetic energy and increase in trajectory. This is periapsis burn.

Case-1: When satellite is at perigee. (With respect to sun)

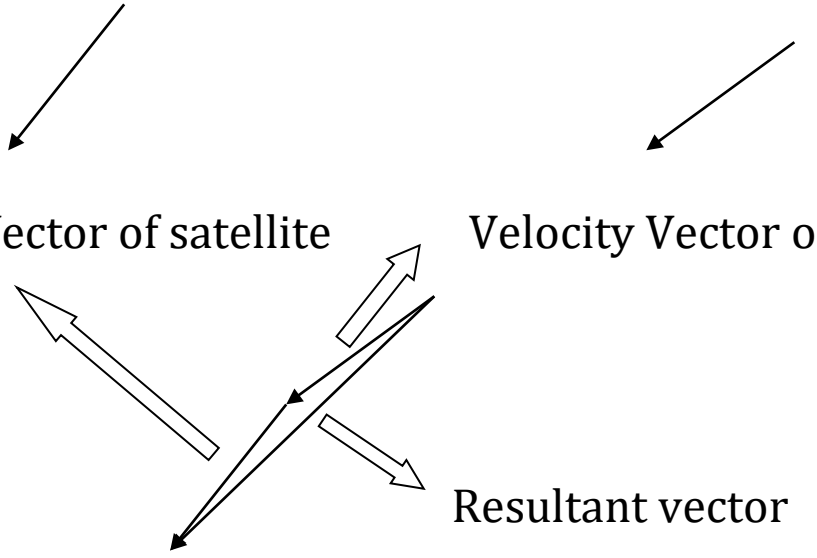
Velocity vector of Earth Velocity vector of satellite



Resultant vector

(Triangle law of addition of two vectors)

Case-2: After passing some distance from perigee



Velocity Vector of satellite Velocity Vector of Earth

Resultant vector

We can observe here the resultant vector has increased.

Results

We observed in the last slide that after passing some distance from perigee, the resultant vector has increased. Thus, we will get velocity gain and increase in trajectory. After six periapsis burns, the velocity of satellite will reach to11.2 km/s (Escape velocity). Thus, it would leave Earth's Gravitation sphere of influence and get lost in space.

Conclusion

This idea suggests that how we can limit the space junk by one of the cheapest means. Proper communication with satellite would play a major role in accomplishing the idea successfully. However, this idea would not be able to remove space junk completely (as we have lost communication with nearly 3000 satellites), but through this idea, the number will not exceed further.

Discussion

Let us have a discussion on the most interesting question.

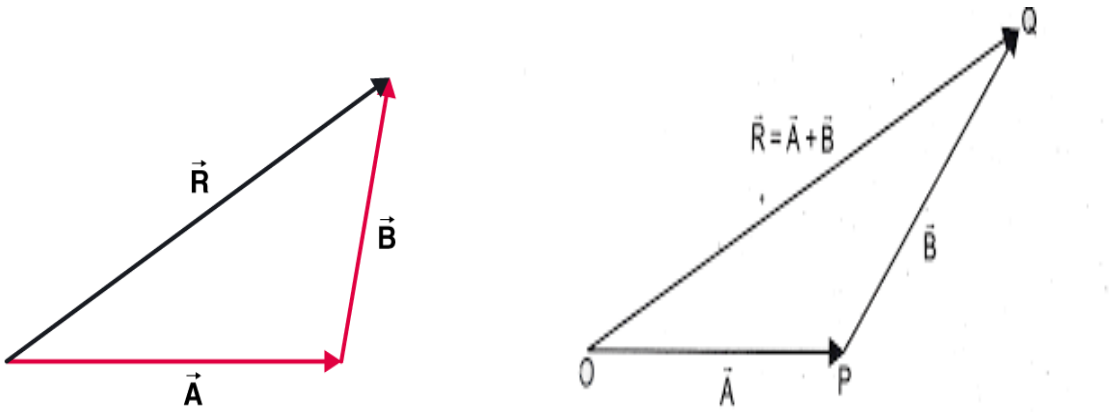
Why does the idea suggest periapsis burn phenomena, but not gravitational slingshot?

Gravitational slingshot around a planet changes a spacecraft's velocity (relative to the Sun) by entering and leaving the gravitational sphere of influence of a planet whereas the periapsis burn means that the most energy-efficient method for a spacecraft to burn its fuel at the lowest possible orbital periapsis, when its orbital velocity (and so, its kinetic energy) is greatest.

Sometimes, gravitational slingshot is confused with periapsis burn, but this is not possible. It is because if a spacecraft is launched from a particular planet, so it is a par t of same system. If it is a part of same system, so it is same as throwing ball on the wall of the moving train. There, the principle of relative motion will not work because you are in rest with respect to train as both train and you are moving with a same speed. But if the system

comes from outside the Earth, and using Earth's gravity it does its trajectory change or velocity gain then we can say it is a gravitational slingshot.

What are the concepts used in periapsis burn phenomena?



Concept 1- In vector addition, if we keep the vectors values same but change the angles, then the resultant will increase.

Concept 2- Kepler's Second Law: Planets move faster when it is closer to Sun and slower when it is farther from sun. Using this law, we can say that when the satellite is closest to Earth (at perigee), its velocity will be at peak.

Concept 3- The work done by the sum of all forces acting on a particle equals the change in the kinetic energy of the particle.

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