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Editorial for Volume 8 Number 1
Characterization in the Transfer of Resources to the International Space Station

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1 Introduction

The International Space Station (ISS) is a larger cooperative effort of the whole history of mankind , more than 20 countries including Japan , Brazil, Canada , USA and of course Mexico , have joined for same goal , to build the first International space Station to guarantee the presence of mankind in space. All countries contribute technology and resources , but most of these come from great power like the United States and Russia, will continue to grow to acquire a weight of 450tn , the station comprises service modules , control and accommodation provided zones survival , navigation, communication and propulsion. It gets its energy through solar panels 110x90m and have required more than 50 pitches to build and cost approximately 200,000MDD.

The objective of the construction of the ISS is the conduct multiple experiments in a State of weightlessness, something that cannot be done anywhere on our planet. Physics, chemistry, biology, medicine, metallurgy are some branches that focus experiments with the aim of providing new alternatives for our everyday life.

Each trip to the ISS requires an investment of 80MDD that inevitably must be, the astronauts who live there dedicated to the development of experiments need as essential as food and water resources, something that cannot get a place so extreme I inhospitable and if all added little, there are many constraints, the space is a place devoid of oxygen and gravity, where temperatures can reach 240 ° c in places with light and - 230 ° in shady places. Great progress has been made in construction engineering to be able to safeguard the integrity of the project and the survival of astronauts

To learn about the complexity of space transport essentially we need to know all paradigms that interfere in the travel, transportation is usually the factor that limits the space efforts. The costs of current releases are very high (from 5000 to 30 000 dollars per kilogram from Earth to the Earth's low orbit - also known as OBT or LEO).

To colonize space, required much cheaper vehicles, as well as a means of preventing serious damage to the atmosphere caused by the hundreds, or even thousands, of launches required, at an altitude of 300km and an average cost of 80 million dollars per launch has required various methods to avoid additional costs not to mention invisible forces that considerably increased the complexity in every routine trip, the space has a temperature of 250 ° in the shade of the Sun and outside this reaches a higher temperature to 250°, having to add objects in constant motion in a possible collision, presenting a countless amount of adversities that are gradually solved.

Fig. 1. ISS. Courtesy NASA.

2 Inclination of the orbital plane

The change of plane should be our last option when it comes to maneuvering in space, so we will have to launch our ship only when the position of our launch Center coincides with the plane of the station. Since the orbit of the ISS remains more or less fixed with respect to the center of the Earth, the only thing we have to do is wait for our planet to rotate and place us under the level of the station. This coincidence takes place twice a day, but normally only we can take advantage of those occasions in which the plane of the ISS pass over our space center in upward direction, i.e. towards the North. The reason for this restriction has to do with the limitations of the direction (azimuth) of the launch space rockets, normally to avoid flying over populated areas. In the case of the space shuttle, not you can peel South with an inclination higher than 39 ° address, requiring that all its launches to the ISS are carried out in North. Something similar happens with the Soyuz.

The Orbital inclination is the angle that is the plane of the orbit with the Earth's equator. A ship in an orbit with an inclination of 0 ° would be limited to turning the earth over the equator. On the contrary, if the inclination is 90 °, the orbit fly the North Pole and the pole South of the planet. It is an extremely important value for several reasons. First, because a satellite can only reach directly a low orbit with inclination equal to or greater than the latitude of the launch Center.

The height of the orbit is a fundamental variable. The further orbit a satellite, the lower its speed. However, the height of an orbit is not constant. As already taught us Kepler a few centuries ago, closed around a body orbits are not circles but ellipses. Call us perigee to the lower height of the orbit point, while the peak is the farthest away from our planet. If the difference between the two is minimal, as in the case of vehicles in low orbit, we can approximate the shape of the orbits to circumference without much error. In the event that the difference is high, we would have a strongly elliptical orbit. The ellipticity of the orbit is measured according to the eccentricity.

With our knowledge of orbital dynamics, we can analyze the steps to dock with the ISS in orbit. Seen, it is clear that we can not throw our ship from any Earth point and at any time. It is only permissible to use centers launch whose latitude is less than the orbital inclination of the ISS. In this case, there is no problem, since the ISS is located in an orbit of 51.6 °, being accessible from the majority of spaceships.

The following limitation has to do with the inclination of the orbital plane. This is more important. We have said that the plane change must be our last option when it comes to maneuvering in space, so we will have to launch our ship only when the position of our launch Center coincides with the plane of the station. Since the orbit of the ISS remains more or less fixed with respect to the center of the Earth, the only thing we have to do is wait for our planet to rotate and place us under the level of the station. Armed with our knowledge of orbital dynamics, we can analyze the steps to dock with the ISS in orbit. Seen, it is clear that we can not throw our ship from any Earth point and at any time. It is only permissible to use centers launch whose latitude is less than the orbital inclination of the ISS. In this case, there is no problem, since the ISS is located in an orbit of 51.6 °, being accessible from the majority of cosmodromes.

This coincidence takes place twice a day, but normally only we can take advantage of those occasions in which the plane of the ISS pass over our space center in upward direction, i.e. towards the North. The reason for this restriction has to do with the limitations of the direction (azimuth) of the launch space rockets, normally to avoid flying over populated areas. In the case of the space shuttle, not you can peel South with an inclination higher than 39 ° address, requiring that all its launches to the ISS are carried out in North.

Obviously, if we apply to strictly the criterion of the orbital plane, we will only have a moment - literally - to perform the take-off, which does not leave us much margin of safety. But, although the change of plane maneuvers are prohibitive, we can tolerate changes of up to 1 ° approximately. If we take into account that the earth rotates 360 ° in 24 hours, this means we have a window of launch of five minutes each day to launch our ship toward the ISS. Naturally, can increase the duration of the launch window a little more, but - do not forget - at the expense of sacrificing the amount of payload.

We might think that the launch window will always repeat the same time every day of the year, but it is not. To make more interesting the lives of astronauts, nature has introduced a series of complications. In fact, the window toward the ISS comes about 24 minutes each day. Why? Maybe because of the precession of the orbit of the station nodes. This strange phenomenon is due to the flattened shape of our planet.

The largest number of mass found in Equatorial regions causes the plane of orbit to rotate slowly but inexorably. Another effect caused by the shape of the Earth is the precession of the perigee. Or said in other words, the position of the orbital perigee moves each day with respect to the center of the Earth. For example, if we have an orbit of 300 x 500 km, the line of apsides (the line that connects with the apogee perigee) will move about 11 ° per day.

Through the collection of information, conducted various tests to compare the data obtained by NASA in this way generate an algorithm mathematician to perform various simulations of shipments to the (ISS) at the end to generate the model more optimal for the transfer of resources

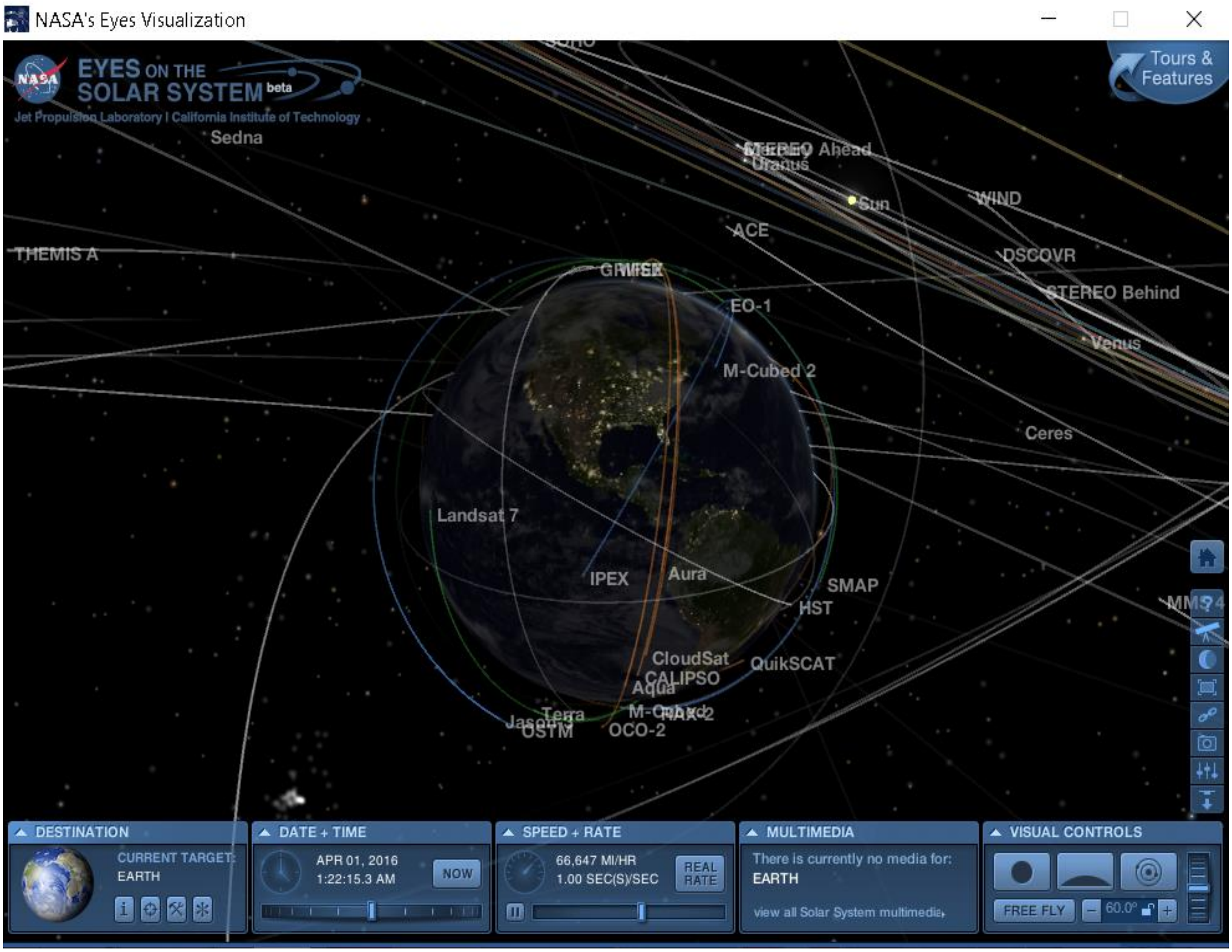

Fig. 2. Simulator, courtesy NASA.

In this way it is possible to perform different tests generating data accurate, reliable, and accurate, all this accompanied by an algorithm in which different (parameters) are considered to determine the most viable option thrown by all this way of data that are generated. To perform the algorithm, considered all the physical constraints of the capsules of transport (Material, size, weight, load, fuel, crew, speed, life, current technology). Similarly considered all the variables, atmospheric, mechanical, and thermal (thrust, drag, temperature point of break, twisting, insulation).

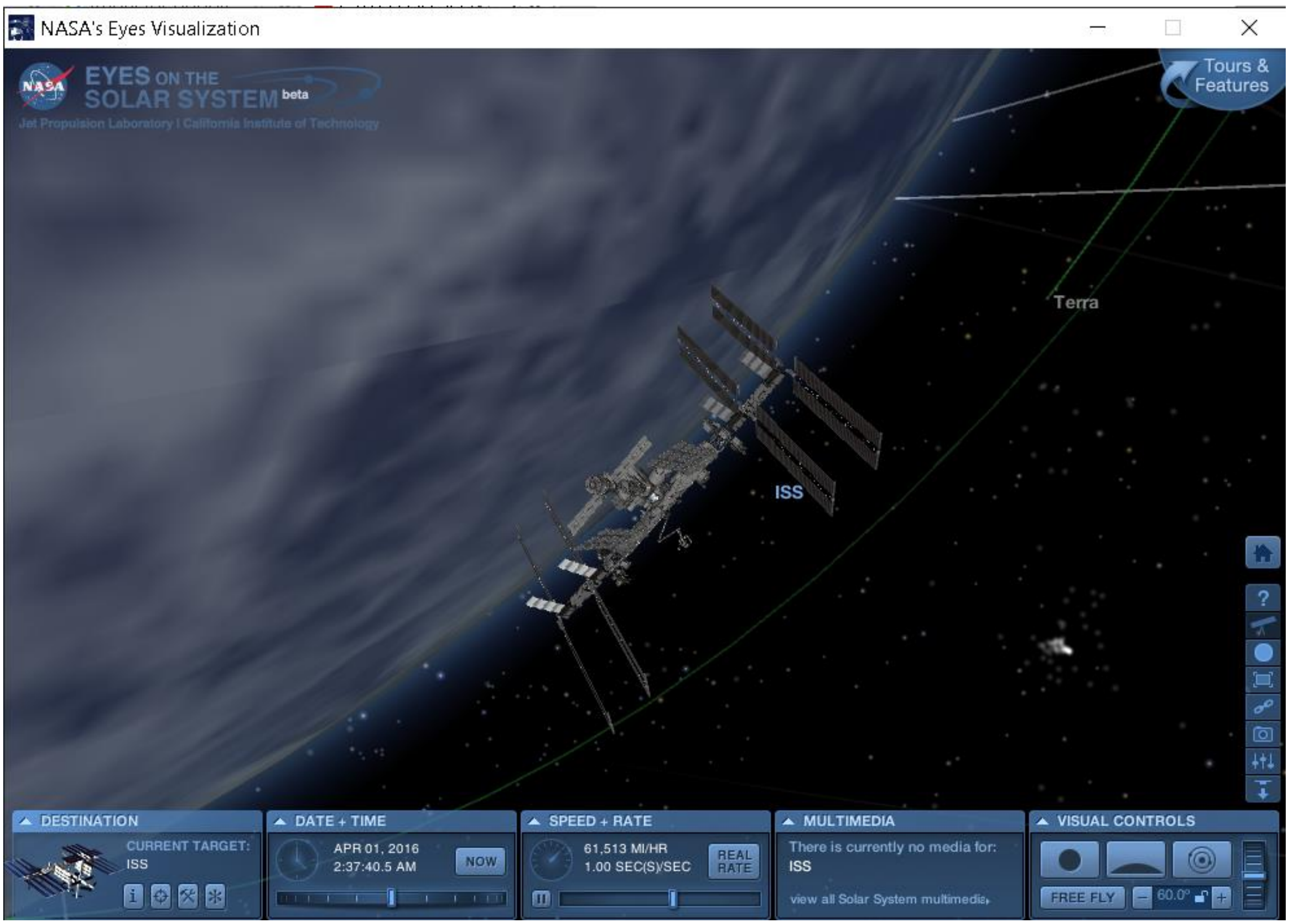

Fig. 3. Simulator 2. Courtesy NASA.