Satellite Navigation

Sysoeva N.V.
Supervisor: Kuimova M.V., Candidate of Pedagogic Sciences
Tomsk Polytechnic University, 30, Lenin Avenue, Tomsk, Russia, 634050
E-mail: nvs28@tpu.ru

Satellite navigation plays a key role in high precision navigation, positioning, timing, and scientific questions related to precise positioning. This system consists of two parts: ground and space equipment. This equipment is intended to establish the exact time, location and motion parameters for water, air and ground objects.

The principle of satellite navigation is based on the measurement of the distance from the antenna located at the facility to satellites. The coordinates of this object must be obtained, and the position of the satellites is to be known with great precision. The table of all satellites is called the Almanac, which should have any satellite receiver before the measurements. Each satellite transmits its own signal. Thus the position of an object in space can be calculated if we know the distance to several satellite systems. Each satellite of navigation system uses radio signals to measure the time.

The system is used in such fields as cartography, geodesy, navigation, cellular communication, satellite monitoring of transport, tectonics, and others. For example in tectonics it is used to observe the movements and vibrations of plates. As for satellite monitoring of transport, it shows the speed of cars and their movements.

At present we use such satellite navigation systems as GPS, GLONASS, DORIS and others. Now we are going to take a closer look at GPS and GLONASS as they are the most popular and large systems. A comparison of these satellite systems makes it possible to determine their advantages and disadvantages.

Table 1 - Comparison of systems GPS and GLONASS [4]

System	**GPS**	**GLONASS**
Owner	United States	Russian Federation
Coding	CDMA	FDMA/CDMA
Orbital height	20,180 km (12,540 mi)	19,130 km (11,890 mi)
Period	11.97 hours (11 h 58 m)	11.26 hours (11 h 16 m)
Evolution per sidereal day	2	17/8
Number of satellites	At least 24	31, including 24 operational 1 in preparation 2 on maintenance 3 reserve 1 on tests
Accuracy (free access)	Position: 3.5-7.8 m	Position: 5-10 m Speed: 0.1 m/s Clock: 200 ns
Accuracy (licensed access)	Position: better than 3.5-7.8 m with ionospheric correction	—
Frequency	1.57542 GHz (L1 signal) 1.2276 GHz (L2 signal)	Around 1.602 GHz (SP) Around 1.246 GHz (SP)
Status	Operational	Operational, CDMA in preparation

Both systems have a dual purpose: military and civil. Consequently they emit two signals: one with the reduced accuracy of coordinate determination for civil implication and the other with high

accuracy for military implication, with a precision of ~100 meters, and ~10 meters, respectively. GPS satellites are located in six planes while GLONASS satellites in turn are located in three planes and at a reduced height. The error of the Russian navigation system without the use of ground stations is about fifty meters while using GPS the error can amount to five hundred meters. This difference is an advantage of GLONASSA. This approach enables to determine the geographic location of an object more accurately, without requiring any additional adjustments.

We considered not all existing navigation systems. In addition to the GPS and GLONASS, developed by Japanese Quasi-Zenith, there is the European Galileo. China and India have also begun to develop their own satellite navigation systems.

The GLONASS market in Russia is only beginning to take shape. But now it is clear that this is a very important and promising component of the economy. The demand for navigation devices that support the GLONASS, is gaining momentum, both in Russia and abroad.

Satellite navigation systems are no longer serve the military purposes, they gradually penetrate in everyday life. More and more devices are equipped with navigation functions ranging from phones to digital cameras.

References:

1. Яценков В.С. Основы спутниковой навигации. Системы GPS NAVSTAR и ГЛОНАСС. М: Горячая линия — Телеком. 2005. 272 с.

2. Соловьев Ю.А. Системы спутниковой навигации. — М.: Эко-Трендз, 2000. 267 с.

3. Bazarov Y. Introduction to Global Navigation Satellite System // AGARD LECTURE SERIES- 207. System implications and innovative applications of satellite navigation. NATO AGARD, 1996.

4. Википедия – сводная энциклопедия [Электронный ресурс] // http:// ru.wikipedia.org (Дата обращения: 13.03.2015).

Mars Colonization Problems

Tarakanets E.A.
Scientific advisor: Ivanova V.S., Ph.D., Associate Professor
Tomsk Polytechnic University, 30, Lenin Avenue, Tomsk, 634050, Russia
E-mail: evgtarak@sibmail.com

Nowadays science and technique are developing very fast, that makes possible the exploration of space and new planets.Now days Mars, the 4th planet of Solar system, is considered as the most perspective planet to explore and colonization. First of all, because this planet has suitable climatic conditions and water supplies.

Some Mars characteristics:

- Mass – 6.4185×1023 kg;
- Volume –1.6318×1011 km
- Surface gravity –3.711 m/s²
- Sidereal rotation period –24h 37m 22s
- Axial tilt –25.19°
- Surface temp –from −143 °C to 35 °C
- Atmospherepressure – 0.636 (0.4–0.87) kPa
- Composition of atmosphere by volume [1]:
  - 95.32% carbon dioxide
  - 2.7% nitrogen
  - 1.6% argon
  - 0.13% oxygen