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TIME ON THE MOON
THE ADVANTAGE OF USING ABSOLUTE LINEAR LUNAR TIME IN CALCULATIONS OF SPACE NAVIGATION ACCORDING TO THE ARTEMIS PROGRAM

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Abstract: It is proposed to conduct all basic navigation calculations in space in the format of absolute linear lunar time. "Directive No. 1 in 2017" on the strategic space policy of the United States, as a state, defined the creation of a space civilization on the Moon and the beginning of mankind's exploration of the entire solar system.

A system of two synchronous space elevators between the Moon and its satellite-platforms at the Euler-Lagrange libration points L1 and the Moon, and L2 and the Moon is proposed. It is proposed to place the "*Capital of the World*" on satellite-platforms at the Euler-Lagrange libration points L1 and the Moon, and L2 and the Moon.

The ergonomic advantages of the ports of launch, arrival and placement of spacecraft at libration points L1 and L2 and the importance of metro transport satellites [MS-satellites] for the organization of communication between satellite-platforms located at Euler-Lagrange points are shown.

Keywords: Capital of the World; Unified Reference Standard Space Transport Schedule [URSSTS]; Unified Reference Standard Space Calendar [URSSC]; format of absolute linear lunar time; Pocket line, Moon trajectory line, "Morozov sphere"; synchronous space elevators of the Moon with platforms at libration points L1 and L2; ports of launch and departure of spacecraft, passengers and cargo from libration points L1 and L2; transport satellites-metro [MS-satellites].

The era of Great Geographical Discoveries has moved into space today. Chronologically, the era of Great Geographical Discoveries covers the XV-XVII centuries. There are 2 stages in this period.

At the first stage (until the middle of the XVI century), the main discoveries were made by the Spaniards and Portuguese. These same countries became the world's first colonial empires.

At the second stage, the Dutch and Russians were active. Some discoveries were made by the British and French. Portugal was the first to search for new sea

routes. In 1488, after circumnavigating Africa, the Portuguese entered the Indian Ocean. Spain soon became Portugal's rival in the search for new trade routes.

In 1492, the Spaniard Christopher Columbus set out in search of India to the west across the Atlantic Ocean. But by now - in the XXI century – there are no unexplored territories left on Earth. Humanity has shifted its attention to near and far space objects. On October 4, 1957, the space age of civilization began – with the launch of the first artificial Earth satellite by Sergei Korolev.

In 2017, on December 11, Trump, the president of the United States, signed "Directive No. 1". The United States has made colonization of the entire solar system its state goal. The United States should become the No. 1 space state by 2036.

The bet is on two intellectual leaders:

a) Elon Musk [SpaceX]; and

b) Jeff Bezos [Blue Origin].

The Moon was chosen as the first stage of colonization of the solar system. The project was named "Artemis 1-11". According to this project, it is planned to make the first 10 missions to the Moon preparatory. Next, annual space flights are scheduled to begin with the “Artemis-6” mission in 2031. And already with the “Artemis-11” mission in 2036, it is planned to open a regularly operating Earth-Moon space line like a conventional airline.

The frequency of flights is gradually planned to increase from about one flight per week to several flights per day.

For this purpose, the development of a new worldwide Unified Space Reference Standard Transport Schedule [USRSTS] has begun, which will take into account the specifics of the space component.

The "Directive No. 1" on the strategic space policy of the United States, as a state, proposes a change in the national state space policy, which provides for a comprehensive program led by the United States with private sector partners to return Americans to the Moon with subsequent missions to Mars and beyond."

On March 26, 2019, US Vice President Mike Pence announced that NASA's Moon landing goal would be accelerated by four years with a planned landing in 2024.

The policy calls on the NASA administrator to "lead an innovative and sustainable research program with commercial and international partners to enable human expansion across the Solar System and bring new knowledge and capabilities back to Earth."

These efforts are aimed at better organizing public, private and international efforts to return people to the Moon and lay the foundation for possible human exploration of Mars. Space Policy Directive No. 1 authorized a campaign focused on the Moon.

On May 14, 2019, NASA Administrator Jim Bridenstine announced that the new program would be named Artemis in honor of the goddess of the Moon in Greek mythology, the twin sister of Apollo [1].

“Artemis” is an American lunar exploration program led by the NASA space Agency, which involves three other partner agencies: The European Space Agency, the Japan Aerospace Exploration Agency and the Canadian Space Agency. The program was officially established in 2017 under the administration of Donald Trump.[2]

On February 4, 2021, the Joe Biden administration approved the Artemis program [3]. Particular, White House press Secretary Jen Psaki expressed "support [for these efforts] by the Biden administration." The launch of the Artemis-1 mission with the Orion spacecraft on board took place on November 16, 2022 at 09:47 Moscow time from the LC-39B launch pad of the Space Center. Kennedy, Florida, USA [4]. The Orion spacecraft spent 25 days in space, including 3 days in the retrograde orbit of the Moon.

On December 11, 2022, at 20:41 Moscow time, the Orion spacecraft successfully returned to Earth. The landing was carried out in the Pacific Ocean. The Artemis I mission was completed successfully [5].

On April 16, 2021, NASA signed a contract with SpaceX for the development, production and execution of two flights to the Moon using the Starship HLS lunar lander [6].

The initial commercial contract was awarded to SpaceX for two Starship HLS missions — one without a crew and one with a crew (as part of Artemis 3). Each of these two missions requires one HLDS launch and several refueling launches, all on SpaceX Starship launchers. As of June 2022, NASA has also exercised an option under the initial contract to commission an upgraded Starship HLS design and a third lunar demonstration mission, in accordance with the new sustainability rules it is developing.

The development of the principles of navigation on the Moon has entered a crucial phase. It is necessary to create a new cosmic world schedule, similar to the world schedule signed in 1918 in Washington under the patronage of Wilson, the President of the United States, to which all the leading states of the world subsequently joined.

It is valid until now. However, with the advent of the space age on October 4, 1957, this worldwide Schedule became obsolete. It does not take into account the specifics and cosmic velocities when using outer space for flights to the Moon and other objects of the Universe.

As part of the Artemis program, NASA plans to send astronauts to the Moon in the coming years and create a scientific base on the Moon for future missions to Mars.

NASA has announced plans to land astronauts on the Moon in September 2026 and fly around the Earth's satellite in September 2025.

In 2023, China announced its intention to send its first mission to the Moon by 2030, and India announced similar plans by 2040.

However, without the introduction of a single standard of time, in particular on the Moon and, in general, in space, it may be difficult to ensure the security of data transmission between spacecraft and synchronization of communications between Earth, lunar satellites, bases and astronauts.

The White House believes that time discrepancies can also lead to errors when working with cartography and geolocation on the Moon itself and its orbit. Therefore, the US government has instructed NASA to develop a unified time standard for the Moon and other space objects.

This problem is discussed in a memo from the head of the White House Office of Science and Technology Policy (OSTP), Arati Prabhakar.

On Earth, most clocks and time zones are standardized according to Coordinated Universal Time (UTC), based on a network of atomic clocks in different parts of the world.

Kevin Hawkins, head of NASA's space communications and Navigation department, draws a figurative analogy between an atomic clock that synchronizes all processes on Earth, which is located at the US Naval Observatory, and the living "heart of the nation." Now he wants to hear the same lively "heartbeat" of the Earth's atomic clock on the Moon.[7]

This should be a new unified global space digital transport IT-Schedule at the same time for

1) railways;
2) water transport;
3) aviation;
4) highways and
5) space activities

– on the basis of a universal (unified) reference standard IT-calendar, the error of which in relation to the average duration of the tropical year is zero ["0"].

This will be a Unified Reference Standard Space Calendar [URSSC], proposed in Russia by Medler (1864), Mendeleev (1899) and implemented by Morozov (2013).

In my work, I synchronized the lunar time zone with all the 24-hour zones of the Earth and combined the time on Earth and on the Moon into a single system based on atomic clocks and the Greenwich meridian zero.[8]
https://calendar-morozov.space/en.html

The Moon makes one revolution around the Earth at the same time during one revolution around its own axis. Therefore, the zone of the lunar time zone has a "zoning coefficient" [ZC] equal to: [1:1=1]. Therefore, time on the Moon is "linear".

The Earth crosses all 24 time zones during one revolution around its own axis (that is, in one full day). The "zoning coefficient" [ZC] of the Earth is [1:24=1/24]. Therefore, time on Earth is "circular".

It will be more convenient to carry out all basic navigation calculations when working on the Moon in units of a single "absolute" or "effective" "linear" lunar time of the Moon, then converting it to "circular" time on Earth, according to one or another "circular" time zone of the Earth.

In space, it will be more convenient to always have the same "linear" lunar time on all its objects [including not only the Earth-Moon system itself, but also Mars, Venus, etc.]. This will completely eliminate any navigation errors and related incidents.

According to the author, all flights in the "Morozov sphere" [8] - in the space enclosed between two conventional lines – the Pocket line, on the one hand, and the Moon's orbit line, on the other hand - should be planned exclusively in units of "linear lunar time".

This is important, since in the area of the "Morozov sphere" all the main production activity of the new space civilization of mankind will develop. The moon and its satellites at points L1 and L2, symmetrically connected to the Moon by space elevators on both sides, would be an extremely interesting place for mass colonization of the Moon.

It would be more efficient to move cargo and passengers to the surface of the Moon and back into space using two main space elevators assembled at libration points L1 and L2.

The final assembly of spacecraft and stations would also be best carried out on space elevator platforms at libration points L1 and L2. There would be no energy costs for their launch into space from the surface of the Moon.

The gigantic size and mass of these space objects would be limited only by the imagination of the builders and their technical capabilities.

When flying to the Moon, both from the Earth and from outer space, it would be more convenient for spacecraft to dock precisely to platforms located at libration points than to carry out an energy-intensive and often quite difficult landing directly on the surface of the Moon each time.

And although the force of gravity on the surface of the Moon is 6 times less than on the surface of the Earth, the launch into space from the surface of the Moon is much more expensive and more difficult than starting from berths at libration points in both directions – both to Earth and from Earth into the vastness of the Universe. Therefore, there is a real future behind the idea of creating the proposed two symmetrical space elevators on the Moon.

"The Earth's moon is a potential location for a lunar space elevator, especially since the specific strength required to attach the cable is small enough to use currently available materials."

"The Moon does not rotate fast enough for the elevator to be supported by centrifugal force (the proximity of the Earth means that there is no effective stationary lunar orbit), but differential gravity means that an elevator can be built through Lagrange points."

"The near elevator would pass through the Earth-Moon point L1 from the anchor point near the center of the visible part of the Moon: the length of such an elevator should exceed the maximum height of L1, equal to 59,548 km, and would be significantly longer in order to reduce the mass of the required counterweight at the top." [9]

"The lunar elevator on the far side will pass through the L2 Lagrange point and should be longer than on the near side; again, the length of the cable depends on the chosen mass of the anchor at the top, but it can also **be made from existing engineering materials.**" [9]

It would be logical if the IAC member states [390 members from 68 countries of the world], at their next congress, made a (at least purely symbolic) decision to create the "***Capital of the World***" of a new space society of space civilization at the "crossroads of three roads" [Earth, Moon and Universe] - on the lunar platforms of two synchronous lunar elevator towers at libration points L1 and L2.

This would be the beginning of the construction, figuratively speaking, of the "Tsiolkovsky Space Rocket Society" - a new [sixth in a row] socio-economic formation [OEF], which will follow the five OEF that have already passed:

1) primitive communal;

2) slaveholding (starting from Egypt under Pharaoh Thutmose III);

3) feudal (starting from the Holy Roman Empire of the German nation under Otto I);

4) capitalist (starting with the creation of the steam engine and railways in Great Britain);

5) socialist and communist (in Soviet Russia and in the USSR)].

The clock in this new conditional "*Capital of the World*" will probably show the absolute linear lunar time of the Universe.

«Philip Ragan, co-author of the book *Leaving the Planet by Space Elevator*, states that "The first country to deploy a space elevator will have a 95 percent cost advantage and could potentially control all space activities."» [10,11]

Both libration zones - L1 and L2 – should be connected by orbits of metro transport satellites [MS-satellites] for fast, reliable and stable communication between astronauts at these Euler-Lagrange points.

On 15 November 2021, an audit of NASA's Office of Inspector General estimated the true cost of the Artemis program at about **$93 billion until 2025**. [12]

The main components of the program are the Space Launch System launch vehicle, the Orion spacecraft, the Lunar Gateway space Station and commercial human landing systems, including Starship HLS. The long-term goal of the program is to establish a permanent base on the Moon and facilitate manned flights to Mars.

The Artemis Program is a collaboration between space agencies and companies around the world, linked to each other by Artemis Agreements and auxiliary contacts.

The agreements were signed on October 13, 2020 by the directors of **eight (8)** national space agencies: the United States, Australia, Great Britain, Italy, Canada, Luxembourg, the United Arab Emirates and Japan.

Later agreements were signed plus **22 national space agencies**: Argentina, Colombia, the Czech Republic, Spain, Ukraine, South Korea, New Zealand, Brazil, Poland, Mexico, Nigeria, Germany, India, Israel, Rwanda, Romania, Bahrain, Singapore, France, Saudi Arabia, Ecuador and Switzerland joined the treaty [13].

Conclusion

The Moon was chosen as the first stage of colonization of the solar system. According to the project, called «Artemis», 10 missions-flights are planned to the Moon of a preparatory nature, starting with the «Artemis-1» mission, successfully conducted in 2022.

Regular annual flights will begin with the «Artemis 6» mission in 2031. And starting with the «Artemis-11» mission in 2036, it is planned to open a regularly operating Earth-Moon space line according to the type of regular avia flights.

The frequency of space flights will gradually increase from about once a week to several flights per day.

Therefore, these space flights should be included in the list of all regular transport schedules:

1) railway,
2) river and sea,
3) automobile,
4) aviation and
5) space.

In this regard, the development of a new Unified Reference Standard Space World Transport Schedule has begun, replacing the normal Standard Transport Schedule that has been in force since 1918.

The new Unified Reference Standard Space Transport Schedule [**URSSTS**] will take into account the specifics of the space component and the 25th lunar time zone according to the type of existing 24 time zones on Earth.

The old *inaccurate* Gregorian Catholic Vatican calendar from 1582, which has an annual lag error of *27 seconds* relative to the average duration of the tropical year, will be replaced by a new Unified Reference Standard Space Calendar [**URSSC**], proposed in Russia by Medler (1864), Mendeleev (1899) and implemented by Morozov (2013), with *zero* the average lag error.

<https://calendar-morozov.space/en.html >

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