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Exploration of Space using Artificial Intelligence

Dr. Ankita Nigam[1],B. Sowmya Reddy[2], B. Sai Santhoshi[3], R. Pallavi [4], P.K. Aparnna[5], Y. Archana[6], M. Rashmitha[7]

Professor[1], Students[2,3,4,5,6,7]

Department of Computer Science Engineering

Princeton Institute of Engineering and Technology for women's Hyderabad, India,

Corresponding Author's Email: - *asaspr06@gmail.com, ankita270481@gmail.com[1]*

Abstract

Artificial Intelligence is being used to resolve problems both small and huge on Earth and beyond. Rapid developments in AI show promise in advancing space exploration by leaps and bounds. From providing personal assistance to astronauts to helping we better understand the Sun, here's how AI can assist in the exploration of space. Artificial Intelligence is already making our lives simpler on Earth, but what about beyond the borders of our planet? Can AI be of use on space missions and for space exploration in general? Today, many companies, such as NASA, ISRO and Google, have already implemented AI to search for new celestial bodies, life on other planets and even streamlining the jobs of astronauts when they are in space.

The Role of AI in Space Exploration:

- *Personal Assistants in Space*
- *Processing Satellite Images*
- *The Role of AI in the Development of Satellites and Spacecraft*
- *Conducting System Monitoring*
- *The High Demand for AI Products Has Increased Demand for Data Annotation Personal Assistants in Space.*

Keywords: - *AIKO, Mirage Library, ISS, ADR, NLP, Artemis Mission, Post-mission disposal guidelines.*

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INTRODUCTION

Artificial Intelligence (AI) is the ability of a Computer program or a machine to think and learn. It is also a field of study which tries to make computers "smart". They work on their own without being encoded with commands. Clearly there is a need to develop or reinterpret 'rules of the road' to enable continued and legally compliant access for commercial and civilian actors in space. The space exploration process is also adopting Artificial Intelligence (AI) and robotics to speed-up its mission. This leads us to great lengths and never explored places. Emerging technologies like machine learning and deep learning are organizations working in space programs an opportunity to embrace AI and robotics. Robots help the space exploration process through the mechanical design of planetary rovers, the mechanical design of space manipulators, actuators and sensors of space robots, end-effect or/tools of space robots, reconfigurable robots, and robot mobility.

Here are some exemplary cases of robotics and AI in space tech.

1. Canadian Space Association launched Dextre, a two armed robot, designed to install and replace small equipment such as exterior cameras or the 100-kg batteries used on the Space Station, and to test new tools and robotics techniques.

2. Voyager 1 and Voyager 2 were designed to conduct close-up studies of Jupiter and Saturn, Saturn's rings, and both Jupiter and Saturn's largest moon. These robots are still communicating information via the Deep Space Network (DSN) and are presently closer to Pluto than to Earth or the sun.

3. Robot 2 follows in the steps of Robot 1, a ground-based prototype designed to help astronauts on spacewalks. Also known as R2, was the first US-built robot on the ISS. It joined the crew back in 2011 without legs, which were added in 2014.

In the next coming years, space activities are expected to undergo a radical transformation with the emergence of new satellite systems or new services which will incorporate the contributions of artificial intelligence and machine learning defined as covering a wide range of innovations from autonomous objects with their own decision-making power to increasingly sophisticated services exploiting very large volumes of information from space. This chapter

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identifies some of the legal and ethical challenges linked to its use.

Governance of space activities is being confronted with a progressive transformation associated with the evolution of satellite systems and space-based services utilizing AI, which includes ML. This chapter identifies and examines some of the fundamental legal challenges linked to using AI in the space domain. The legal challenges developing or appearing from the reliance and use of AI in space necessitates establishing the existence of linkage between space systems and services using AI to a system of governing rules and guiding legal principles. The nature of the space and satellite industry presents a quintessential use-case for AI. Essentially, virtually all space activities and ventures constitute fertile ground ripe for employing AI.

Indeed, AI is ripe for use in Earth orbit activities like active debris removal ("ADR"), near Earth ventures such as abiotic resource extraction, and deep space exploration. Space is undergoing seismic shifts driven by New Space (promoting a Smart, Fast and Now Space)

The GAFA web giants, newcomers, venture capital firms and start-ups. There is significant growth in number of space activities, space objects, and space actors. However, new challenges emerge in the course of such active exploration and use, whilst deploying AI in space. Elaborating upon a forward-looking perspective, harnessing AI and ML technologies in accessing and exploring outer space, as well as engaging in space. These risks are more acute when acknowledging important facets in the space field. Firstly, space is a service and-needs-oriented market dominated mostly by demand and competitive industry logics, without a main centralized regulatory body. Secondly, there is an increased ubiquitous repercussion of space activities on Earth, since the benefits and solutions that space provides for the problems and needs of mankind are becoming ubiquitous (transport, smart city management, security, agriculture, climate change monitoring, etc.) In this line, European Space Agency (ESA) estimates that for every Euro spent in the sector, there has been six Euros benefitted to the society. This correlation reflects a more highlighted dependence of Earth from space-based services.

The breadth of these space-based services – much of these AI-enabled – requires consideration of a broad range of legal

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and regulatory issues that the space industry alone cannot answer. Also, UN Space Treaties leave much uncertainty about permitted

REVIEW OF LITERATURE

1. Shashi kumar and Himanshu Govil (2022), Studied about the "Advances in Spaceborne SAR Remote Sensing for Characterization of Natural and Manmade Features-Part 1". The Polarimetric Synthetic Aperture Radar (PolSAR) systems use electromagnetic radiations of different polarizations in the microwave frequency to collect the scattering information from targets on the Earth.
2. Naukowy, (2012), Studied about the "Journal of Space Exploration". The journal of Space Exploration covers all aspects of special emphasis on space and planetary exploration, earth observation, mission analysis, spacecraft and payload design, galaxy, navigation and control, related space technology etc,.

AI Applications in space exploration

Autonomous rovers

Space autonomous rovers are one of the most important AI applications. These rovers roam planet surfaces, currently on Mars, and need to make decisions and avoid obstacles while calculating the best routes without mission control's say-so. Autonomous rovers are behind some of the most important discoveries made on Mars.

Assistants and robots

A sub-field of neural language processing (NLP), sentiment analysis, (also known as emotion AI or opinion mining) is behind the work conducted by scientists to create intelligence-based assistants that will support astronauts in future missions to the Moon, Mars, and more. Sentiment analysis will extract and recognize opinions from text data, like reviews, forums, social media, and more. These assistants will then understand and anticipate the needs of the crew, alongside understanding mental health and emotions so that actions can be taken in case of an emergency. Robots can also be helpful in physical tasks, such as docking, spacecraft navigation, and more.

Intelligence navigation system

Google Maps use navigation systems like GPS to map out our planet, however, we don't currently have a similar tool for extra-terrestrial objects. Without navigation satellites around Mars or the Moon, scientists have to get creative.

In collaboration with Intel, a team of researchers from NASA developed an

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intelligence navigation system in 2018. This system uses AI to explore planets, and the model was trained on millions of photos from several missions to create a virtual Moon map.

Satellite data processing

Satellites generate massive amounts of data; Maxer Technologies, a space tech company in Colorado, has more than 110 pet bytes in image data, adding over 80 terabytes a day. AI algorithms help to process this data efficiently. Machine learning algorithms can study millions of images in seconds, analyzing changes in real-time. Automating these processes with AI allows satellites to independently take images when sensors detect specific signals. Researchers from Leeds University in the UK analyzed images collected by ESA's Gaia satellite and applied machine learning techniques to the data, finding over 2,000 new proto stars new , which are infant stars forming in gas and dust clouds. AI can also help in remote satellite health monitoring, predicting performance and issues for informed decision-making.

Mission design and operations

AI can help with autonomous operations in space missions. AIKO, an Italian start-up business, developed Mirage, which is a software library for enabling operations in space missions. This is part of ESA's tech transfer program. It allows the spacecraft to perform autonomous re-planning and detect both internal and external events, so it can take appropriate action so the ground-based decision-making doesn't affect the mission objectives. With AI and machine learning, it's also possible to evaluate operational risk analysis and determine safe critical missions. Risk mitigation systems can then process large amounts of data from normal operations and previous performance. After teaching a model to identify risk classification, it can then conduct real-time risk assessments.

Mission strategy

The Entry, Descent, and Landing (EDL) flight dynamics team relied on AI for both complex scheduling systems and mission planning to get through the "seven minutes of fear" during the Perseverance mission. Scientists and engineers see scheduling as something AI can help with, as systems need intricate planning, and would otherwise require large amounts of manpower. Spacecraft can be programmed to determine autonomously how to execute commands according to specific functions based on past data and environment.

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Space debris location

ESA states that there are almost 34000 objects bigger than four inches threatening the exiting space infrastructure. Satellites deployed in the low Erath orbit can be designed to completely disintegrate in a controlled way, so as to prevent space debris. There's also the possibility of collisions with space debris, something that researchers are actively working on to prevent. This can be done by designing collision avoidance Maneuvers through machine learning techniques, or by training machine learning models and transmitting these into spacecraft in orbit to improve decision-making. Similarly, already trained networks on board spacecraft can help guarantee space flight safety, allowing for increased flexibility in satellite design while minimizing orbit collision.

Data collection

AI automation will be helpful in optimizing the large amounts of collected data from scientific missions like deep space probes, Earth-observing spacecraft, and rovers. It'll also aid in evaluating this data and distributing it to end-users. Through installing AI aboard spacecraft, it'll be possible to build datasets and maps, as AI could find and classify normal features, like common weather patterns, from a typical patterns, like smoke from volcanic activity - all done independently. But how do we know which datasets need to be sent to end-users for processing? AI technology can minimize or eliminate unimportant data, so that networks can work more efficiently when transmitting large amounts of data.

Exoplanet discovery

The Kepler's Telescope was built to help determine the frequency of Earth-sized planets that orbit Sun-like stars, which needed both precise and automatic assessment of the candidates - even with a low signal-to noise ratio. Alongside other scientists, Google got around the constraint by developing Astro Net K2, which is a convolution neural network (CNN). This CNN can establish whether a signal from the Kepler Telescope is an actual transiting explants instead of a false positive. After training the neural network model to 98% accuracy, two new explants' were found: Kepler 80g and Kepler 90i, which respectively circle the Kepler 80 and Kepler 90 star systems.

Scope of AI in Space

By ISRO

By December 2021, India Will Send Man to Space: ISRO Chief K Sivan recently talks About Future Missions. He has also

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asserted that though ISRO's plan to soft-land Chandrayaan-2's 'Vikram' module on the lunar surface did not go as per the script, this will have no bearing on the 'Gaganyaan' mission.

India is making rapid progress in the arena of technology and science. Gone are those days when India was satirically referred to as the land of "Snake Charmers." In recent times, native Indian rockets as high as multistoried buildings that are seen roaring in skies piggybacking bulky satellites. This clearly indicates that the Indian space program is now absolutely self-reliant and completely prepared to explore the dark secrets of the universe. After the first moon landing mission called Chandrayaan-2, ISRO is not sitting idle. In fact, ISRO or The Indian Space Research Organization will not have time to rest as they are busy preparing for their next schedule.

The best part is the usage of artificial intelligence in the Chandrayaan-2 project. As ISRO has used the human robots and AI method, this is why they were expecting the success. An overview of ISRO’s next projects using Artificial Intelligence Other AI systems are going to help each and every astronomer to recognize various possible gravitational lenses, which play a very important role in connection with research into dark matter. AI’s skill and capability to sift through humongous amounts of data and find correlations helps in intelligently analyzing that data.

ESA’s ENVISAT produced around 400 terabytes of data every year. On the other hand, the astronomers’ approximation that the Square Kilometre Array (SKA) an international effort to build the world’s largest radio telescope situated in both the South Africa’s Karoo region and Western Australia’s Murchison Shire will produce 35,000-DVDs-worth of data every second, equivalent to data and information that the internet produces daily. How would such mountains of data be analysed if it's not for AI?

BY 2021 India will send a man to space-ISRO Stating Chandrayaan-2's orbiter will offer you the data for seven and half years, he said all technologies of the moon mission have simply proved precise except for the soft landing. "Is not it a success?" ISRO chief K Sivan asked. Though one project has failed, ISRO is all set to come up with amazing projects using AI, which will surely surprise the country. They have claimed that by December 2021, they will surely have their first unmanned mission

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of the human space plane. The second unmanned human space plane, which they target for July 2021, Sivan said, addressing the eighth convocation of IIT, Bhubaneswar. One of the biggest claims he has done is that by December 2021, the first Indian will be carried by our own rocket. With that, the human robot is going to be a major part in their projects too. Therefore they are working on a new target by discovering new features of Artificial Intelligence. According to a few sources, they have started experimenting with the human robot with the help of AI. A lot of people out there think that as the Chandrayaan mission has failed, ISRO will not be able to make some of the impactful projects. But according to ISRO, they will again take a chance to send the human robots through Artificial Intelligence to Mars or Moon. As they are going to start their upcoming projects, they will take a great care on the human robots so that they can create history by sending AI robot to space.

April 2020 (estimated): Aditya-L1 mission The Aditya-L1 mission is mainly ISRO's first planned probe to study the Sun's corona and its atmosphere. The corona is considered as the outer layer of the Sun, and that extends thousands of km above the visible disc around it.

December 2021/January 2022: Gaganyaan mission Along with the Aditya-L1 mission, India will attempt to send the astronauts to space on a spacecraft called the2 'Gaganyaan' by 2022. The mission will surely make India only the fourth nation in the world to achieve the feat if successful, he added as they will send human robots to space. At Rs 10,000 crore, Gaganyaan will be slated as India's biggest, boldest space mission so far. AI robot launches new era of space travel Along with ISRO, there are lots of organizations that use AI and human robot to create some new technology. In recent times, CIMON, the AI-powered robot, launches a new era in space travel. German Aerospace Centre DLR and IBM are actually preparing for the future of spaceflight with CIMON. They are nowadays using the ISS as the test bed to prove the idea and technologies for an AI robot, which could be utilized on deep space missions. Also, they are already preparing for missions where we'll send humans to Mars and beyond. Once they reach that certain point, communicating with and getting answers from the ground becomes problematic; this can take 30 minutes to get the answer to a simple question only because of distance.

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That's where people think an AI-powered assistant running on an on-board cloud server could support these future missions. Eventually they have tested CIMON and then they have explored that Artificial Intelligence is going to make the organization successful as they are going to do great work on something which sometimes seems a little bit close to science fiction.

By Roscosmos (Russia)

Russia is on its Way to Rule Space with its New AI Powered Space Station at present, AI is being used in almost every industry on earth and now it's time for it to go to space. Russia's new space station will operate autonomously to a large extent, using artificial intelligence as well as include extravehicular robots. The system aims to demonstrate the intelligence of the highest level. The Roscosmos (a state corporation of the Russian federation) chief has added that robotics should be used aboard Russia's new orbital station. The new orbital outpost in conjunction with the Zeus nuclear-powered space tug can serve as a prototype for future systems of lengthy inter-planetary flights, he said.

The agency aims to develop the new space station with a higher efficiency factor than that of the current International Space Station (ISS). In April, Russian Deputy Prime Minister Yuri Borisov announced that the condition of the ISS left much to be desired and Russia might focus on creating its own orbital outpost. The country wants to make a station whose efficiency factor will be several orders of magnitude higher than that of the ISS. It is reported that Roscosmos will start deploying the new Russian Orbital Service Station (ROSS) in five-six years. This will be a completely new generation of orbital modules. The new station will feature open architecture and similar modules will replace each other when they use up their service life. Appearing to preempt that decision, the head of Roscosmos Dmitry Rogozin posted a video on the Telegram messaging app, adding that "the first core module of the new Russian orbital station is in the works", with the aim of having it ready for launch in 2025. Russia recently celebrated its proud history in space, marking the 60th anniversary of Yuri Gagarin became the first human to go into orbit. For years, Russia had a monopoly on manned space flight but last year NASA astronauts were taken to the ISS via a capsule belong to Elon Musk's Space.

By ESA (Europe)

Going from these basic activities to real space applications may seem like a big

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step but ESA is already starting to use AI and ML in its space missions. For example, rovers can navigate around obstacles by autonomously finding their way across 'unknown' fields. Artificial intelligence is also aiding astronauts on board the International Space Station, more details of which can be found in the next section of this article.

ESA's Hera planetary defence mission will make use of AI as it steers itself through space towards an asteroid, taking a similar approach to self-driving cars. Whilst most deep-space missions have a definitive driver back on Earth, Hera will fuse data from different sensors to build up a model of its surroundings and make decisions on board, all autonomously. Meanwhile on Mars, intelligent data transmission software on board rovers removes human scheduling errors which can otherwise cause valuable data to be lost. This increases the useful data that comes from our planetary neighbour. The same technology could also be used in long-term missions that will explore the Solar System, meaning that they will require minimal oversight from human controllers on Earth.

Satellites orbiting Earth also require more autonomy, as they need to make more frequent collision avoidance manoeuvres to evade increasing amounts of space debris. In January 2021, ESA and the German Research Centre for Artificial Intelligence (DFKI) established ESA Lab @DFKI, a technology transfer lab that works on AI systems for satellite autonomy, collision avoidance capabilities and more.

Furthermore, ESA has gained ample experience using AI to plough through enormous amounts of data to extract meaningful information. This technique has already been implemented in more 'Earthly' applications, including monitoring the number of cars at a shopping centre, predicting retailers' financial performances, monitoring climate change and supporting police forces in their efforts to catch perpetrators.

Earth observation is one area that AI is already being used more extensively. ESA is currently working towards a Digital Twin of Earth, a replica constantly fed with Earth observation data and Artificial Intelligence to help visualise and forecast natural and human activity on the planet. Furthermore, ESA's 'Rapid Action Earth observation' dashboard is showing how AI can be used to monitor economic indicators – for example, the combination

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of commercial satellite data and AI has been used to monitor production changes at a car manufacturer in Germany and plane traffic at Barcelona airport. And FSSC at – launched in September 2020 – is the first European Earth observation mission to carry AI on board, in the form of the ϕ-sat-1 AI chip. ϕ-sat-1 is improving the efficiency of sending vast quantities of data back to Earth.

A major challenge for the shipping sector is the safe and efficient autonomous navigation of the seas. An ESAled project is already applying AI to achieve autonomous situational awareness, enabling a ship to reliably sense its own environment. These AI systems would initially be deployed to support human crews, with crewless ships a longer-term goal.

By JAXA (Japan)

Japan developing rockets with artificial intelligence Japanese researchers are working to develop rockets that have artificial intelligence, making it easier than ever to send communications satellites into space. Adam Hadhazy at Tech News Daily writes that Japan seeks cost savings as the impetus for smarter rockets, allowing for greater automation in pre- and post-launch diagnostic tests. If proven successful, a more intelligent rocket could even control its own trajectory. Japanese researchers are working to develop rockets -- well, technically the launch vehicles that guide them - that have artificial intelligence, according to a new report. Currently, rockets are automatic, but not intelligent. They have some degree of automation and are equipped with sensors that trip when malfunctions occur -- but the sensors can neither inform the operator what the problem is no offer a solution.

But the sensors in the Epsilon launch vehicle will interact, operating more like a rudimentary “brain” and less like a series of switches. It will be able to determine the cause of a problem and potentially fix it on-the-fly.

The Japanese Space Agency (JAXA) also developed an intelligent system that took pictures of experiments in the ISS Japanese module, KIBO. JAXA's Int-Ball operated autonomously and could take pictures and videos. It was developed to promote the autonomy of extra- and intra-vehicular experiments, while seeking to acquire the robotics technology necessary for future exploration missions.

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By NASA

NASA using AI and Machine Learning for space exploration NASA is also using AI for many applications, and has set up an Artificial Intelligence Group that performs basic research that supports scientific analysis, spacecraft operations, mission analysis, deep space network operations and space transportation systems. The Agency investigated making communication networks more efficient and reliable using cognitive radio, which picks out the 'white noise' areas in communication bands and uses them to transmit data; this maximizes the use of the limited telecommunication bands available and minimizes delay times. It also recently applied AI to calibrate images of the Sun, improving the data that scientists use for solar research. For deep-space exploration NASA has also looked into designing more autonomous spacecraft and landers, so that decisions can be taken on-site, removing the delay resulting from communication relay times.

NASA has also cooperated with Google to train its extensive AI algorithms to effectively sift through the data from the Kepler mission to look for signals from an exoplanet crossing in front of its parent star. This successful collaboration quickly led to the discovery of two new exoplanets previously missed by human scientists. After its initial success the project is plugging through data from other missions to continue its search for new planets.

NASA has previously used AI in human spaceflight, scientific analysis and autonomous systems. It currently has multiple programs that use AI/ML: CIMON, which is “Alexa for space”; Ex: MC, medical care AI assistance; ASE, autonomy for scheduling in space; Multi-temporal Anomaly Detection for SAR Earth Observations; FDL, partnership between industry and NASA through AIMs; and robots, and rovers.

RESULT

Yes ISRO employs machine learning at various places. The major area of application is pattern recognition and classification in Remote Sensing. India is a eader in this field. All the major classification algorithms use Mahalanobis distance for segregating different classes.

The Mahalanobis distance was given by the great Indian statistician P. C. Mahalanobis. Various Machine learning algorithms are used for solving complex optimization problems. Genetic algorithms, Artificial-neural network and fuzzy logics are vigorously used in finding solution for various Engineering problems.

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Weather prediction is also one of the areas where you cannot avoid Machine Learning tools. “If we take the global launch history, the failure rate is 10 per cent. Out of the 200 or so launches ISRO has made, our failure rate is only 5 per cent,” he added NASA has the second-highest success rate of all 11 agencies at 17% Despite successfully launching India's brand new Rs 56 crore rocket on its maiden flight, ISRO's Small Satellite Launch Vehicle (SSLV) mission ended up being unsuccessful.



Fig 1.1: Crew-6 is targeted launch to the international space station from NASA’s kennedy Space centre in Florida .



Fig 1.2: The International Space Station in low Earth orbit.

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Past

Earth Observing-1 — The satellite EO-1 (Earth Observing 1) has been successful in the past in gathering images of natural calamities. The AI functioning with it started to take pictures of the calamities even before the ground crew knew that the incident had taken place. It was the first satellite – to map active lava flows from space; to measure a facility's methane leak from space; to track re -growth in a partially logged Amazon forest from space.

SKICAT- SKICAT (Sky Image Cataloging and Analysis Tool) identified what was beyond human capabilities. It classified approximately a thousand objects in low resolution during the second Palomar Sky Survey.

Present

Kepler data — AI, with NASA and Google, made 2017- the year of discovery of two obscure planets. Kepler-90, now-Kepler-90i.

CIMON- Crew Interactive Mobile Companion is basically, a head-shaped robot, used in the International Space Station. The device is an AI-based assistant for astronauts. It is capable of hearing and seeing and serves through searching for objects, inventory management, documenting experiments, videography, and photography.

Future

GPS in Space — NASA Frontier Development Lab has been working on an AI application that would do the job of a GPS in space and would make it easy to explore Titan, Mars, or even the Moon.



Fig 1.3: The H3 launch vehicle was rolling to launch pad (LP2) at Tanegashima Space Centre

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Fig 1.4: Space Transportation Systems> HTV-X > Japanese Experiment Module "Kibo" > Crew Equipment Interface Test

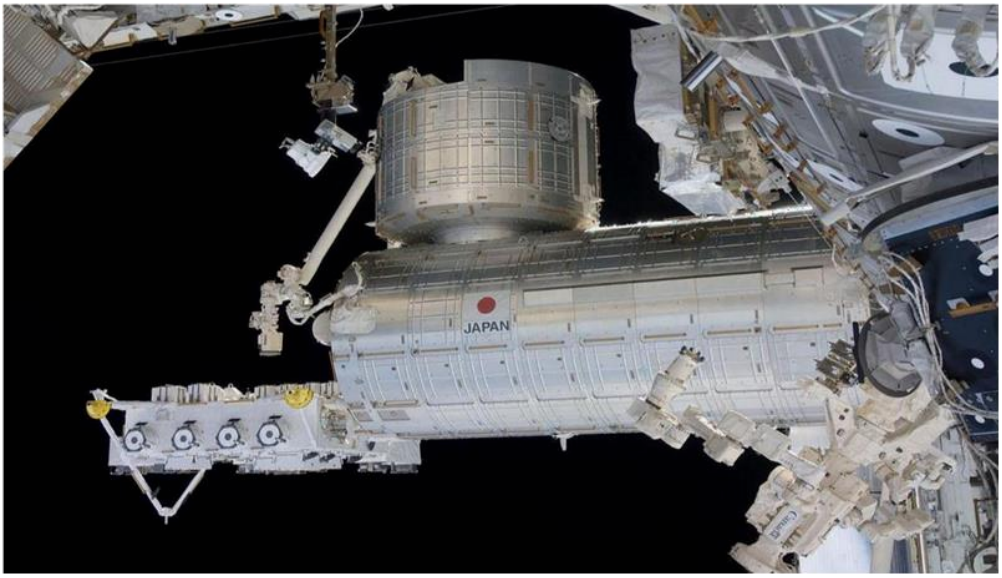


Fig 1.5 ISS Launches Largest Satellite

The Japanese Experiment Module Kibo laboratory and Exposed Facility are featured in this image photographed by a crew member on the International Space Station while Space Shuttle Endeavour (STS127) remains docked with the station.

ESA is now constructing a fourth 35 m-diameter antenna in order to meet the rising demand for communication bandwidth as the Agency prepares and launches a new generation of its own deep-space and space safety missions

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Fig 1.6 NASA Space Station Worms



Fig 1.7: Hylas-1 was launched from Europe's Spaceport



Fig 1.8 Russia Space Station Unveils model

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Fig 1.9 The Soyuz TMA-15 Launch

Russia unveils model of proposed space station after leaving ISS Roscosmos space agency developing orbital outpost as it prepares to end partnership with the west. The chief of Russia's space agency Roscosmos confirmed that it will leave the International Space Station after 2024 and focus on developing its own orbital outpost.

CONCLUSION

Today, the amount of data that is generated, by both humans and machines, far outpaces humans' ability to absorb, interpret, and make complex decisions based on that data. Artificial intelligence forms the basis for all computer learning and is the future of all complex decision making. The energy sector is already using AI/ML to develop intelligent power plants, optimize consumption and costs, develop predictive maintenance models, optimize field operations and safety and improve energy trading. If management is the process of noticing and properly assigning talent, then an AI might well be better able to do that. There is another theory that AI might make people so capable of organizing on their own that managers will become less important and one can run their business just with the technology. We can also use AI and machine learning to assess safety-critical missions and evaluate operational risk analysis. These technologies allow for risk mitigation systems to process large amounts of information based on indicators from nominal operations and past performance where deviation occurred.

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AIML stands for Artificial Intelligence Modeling Language. AIML is an XML (extensible mark-up language) based mark-up language meant to create artificial intelligent applications. AIML makes it possible to create human interfaces while keeping the implementation simple to program, easy to understand and highly maintainable. Current space exploration missions use AI and machine learning capabilities in many areas of space operations including mission planning and operations, data collection, autonomous navigation and maneuvering, and spacecraft maintenance. Future missions will need to rely on the same.

How AI is changing the world? AI allows learners to study from any place in the world, at their own pace, setting their own goals and following a personalized study program that adjusts to their necessities and availability. Artificial intelligence is shaping the future of humanity across nearly every industry. It is already the main driver of emerging technologies like big data, robotics and IOT, and it will continue to act as a technological innovator for the foreseeable future. Artificial intelligence and machine learning (+500%) topped the list of fastest-growing skills, followed by cost reduction (+400).

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