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# AI IN SPACE TECHNOLOGY

### Mrs. PARIMALA. S. SORATUR

#### Senior Grade Lecturer

Department of Electronics & Communication Engg. Government Polytechnic, Vijayapur

### Mr. MUDDANNA. B. BHIMANAGAR Senior Grade Lecturer

Mr. RAJKUMAR.B.TALIKOTI Senior Grade Lecturer

Department of Electrical & Electronics Engg. Government Polytechnic, Vijayapur Department of Civil Engineering. Government Polytechnic, Vijayapur

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#### Abstract

Artificial intelligence is a broad field, which refers to the use of technologies to build machines and computers that have the ability to mimic cognitive functions associated with human intelligence, such as being able to see, understand, and respond to spoken or written language, analyze data, make recommendations, and more. Artificial intelligence has been making waves in recent years, enabling us to solve problems faster than traditional computing could ever allow. And as much AI has helped evolving the civil (day today) services of its users, it's also promisingly evolving for space exploration (after all that's the actual birth place of an AI). India too has been generating indigenous AI technology to power its space missions. Take for example its Chandrayaan-2 mission that was launched in July 2019. AI helps analyse the huge amounts of data emanating from space exploration and this helps advance space exploration with each passing day.Although artificial intelligence is often thought of as a system in itself, it is a set of technologies implemented in a system to enable it to reason, learn, and act to solve a complex problem.

#### **1.Introduction**

Space Exploration has always been of interest to scientists and governments across the globe as it holds the key to the origin of mankind and many

marvelous wonders of the universe including the possibility of alien lives. The visible universe represents the parts of space that we can see using telescopes. Yet, scientists and explorers do believe that the universe may be larger than that. Increasing the levels of autonomy and automation using techniques from artificial intelligence allows for a wider variety of space missions and also frees humans to focus on tasks for which they are better suited. In some cases autonomy and automation are critical to the success of the mission. For example, deep space exploration may require more autonomy in the spacecraft, as communication with ground operators is sufficiently infrequent to preclude continuous human monitoring for potentially hazardous situations.

### 2.Knowledge of Artificial Intelligence

Artificial Intelligence is an approach to make a computer, a robot, or a product to think how smart human think. AI is a study of how human brain think, learn, decide and work, when it tries to solve problems. And finally this study outputs intelligent software systems. The aim of AI is to improve computer functions which are related to human knowledge, for example, reasoning, learning, and problem-solving. The objectives of AI research are reasoning, knowledge representation, planning, learning, natural language processing, realization, and ability to move and manipulate objects. There are long term goals in the general intelligence sector.

### **3.About Space Tech**

Advanced space technologies are needed to enable many potential space activities and to reduce the cost and improve the performance of others. The National Aeronautics and Space Act of 1958, which created the National Aeronautics and Space Administration (NASA), directed the agency to conduct the nation's civil space activities to contribute materially to "the preservation of the role of the United States as a leader in aeronautical and space science and technology..." (Space Act, 1958). Subsequent national space policies have reaffirmed NASA's responsibility for the development of advanced civil space technologies (The White House, 1989,1996). If NASA is to continue its drive for more capable and cost effective missions into the twenty- first century, it will need advanced and innovative technologies-some of which may require years to develop and mature. The commercial space industry other and government agencies could provide some of these technologies, but some critical technologies will require long lead- time NASA research and technology development (R&T) to ensure that they are available when required. NASA also will have to develop a plan and mechanism to support advanced technology development for the long term if it intends to be a source of technology for industry and other government programs in the new century.



## 4.SpaceX

Exploration Space **Technologies** Corp., as SpaceX, commonly referred to is an American space technology company headquartered at the Starbase development site near Brownsville, Texas. Since its founding in 2002, the company has made numerous advancements in rocket propulsion, reusable launch vehicles, human spaceflight and satellite constellation technology. SpaceX is the world's dominant space launch provider, its launch cadence eclipsing all others, including private competitors and national programs like the Chinese space program. SpaceX, NASA, and the United States Armed Forces work closely together by means of governmental contracts. SpaceX was founded by Elon Musk in 2002 with a vision of decreasing the costs of space launches, paving the way to a sustainable colony on Mars. In 2008, Falcon 1 successfully launched into orbit after three failed launch attempts. The company then pivoted towards the development of the larger Falcon 9 rocket and the Dragon 1 capsule to satisfy NASA's COTS contracts for deliveries to the International Space Station. By 2012, SpaceX finished all COTS test flights and began delivering Commercial Resupply Services missions to the International Space Station. Also around that time, SpaceX started developing hardware to make the Falcon 9 first stage reusable. The company demonstrated the first successful first-stage landing in 2015 and re-launch of the first stage in 2017. Falcon Heavy, built from three Falcon 9 boosters, first flew in 2018 after a more than decade-long development process..These milestones delivered the company much-needed investment and SpaceX sought to diversify its sources of income. In 2019, the first operational satellite of the Starlink internet satellite constellation came online. In subsequent years, Starlink generated the bulk of SpaceX's income and paved the way for its Starshield military counterpart. In 2020, SpaceX began to operate

its Dragon 2 capsules to deliver crewed missions for NASA and private entities. Around this time, SpaceX began building test prototypes for Starship, which is the largest launch vehicle in history and aims to fully realize the company's vision of a fully-reusable, costeffective and adaptable launch vehicle. SpaceX also developing its is own space suit and astronaut via its Polaris program as well as developing the human lander for lunar missions under NASA's Artemis program. SpaceX is not publicly traded; a space industry newspaper estimated that SpaceX has a revenue of over \$10 billion.

## **5.AI assisting Commercializing Space**

Even before modern computers became a reality, science fiction gave us a plethora of examples of artificial intelligence and smart robots in the context of outer space. From Hal in 2001: A Space Odyssey and the computer on Star Trek to C3PO and R2D2 in Star Wars and even the fantastic machines in Hitchhiker's Guide to the Galaxy, it seems that AI and space go together. While those examples are fiction, we are indeed starting to see examples in the real world where we are using artificial intelligence to help commercialize space.

## 6.The Importance of Artificial Intelligence in Space Technology

Artificial intelligence has transformed many areas of our daily lives. From healthcare to transport, tasks usually carried out by humans are now being performed by computers or robots, more quickly and efficiently. What's more – AI is adapting. It's now bringing us closer and closer to the stars, with numerous benefits.

Here's a closer look at the importance of artificial intelligence in space technology.

The need of AI Artificial intelligence allows computer systems to work with the intellectual processes of humans. However, these machines can carry out tasks more dexterously and efficiently than people. They can also enter hazardous environments, such as areas that require deep sea diving, making certain processes much safer.

In short-AI is improving the way we work. It's not about replacing humans, rather, changing our workplaces for the better.

How AI Powers Space Missions Like Those of SpaceX's– A Study On May 30, 2020 a SpaceX Falcon 9 rocket carrying Crew Dragon was launched at 3:22 p.m. US Eastern Time from the Kennedy Space Center, this being the first time a space mission was launched by NASA since it decommissioned its ageing and unsafe Space Shuttle fleet in 2011. The rocket was successful in deploying the vehicle into orbit and safely returning to Earth.

## 7. The Mission

Aboard the Crew Dragon are astronauts Bob Behnken and Doug Hurley who are tobe launched into the International Space Station. The mission marks the first time a private company has pulled off a crewed mission into low Earth orbit, a report said. The Crew Dragon and its self- landing, reusable Falcon 9 rocket is owned by SpaceX, who's founder and CEO is Elon Musk. NASA just rents the spacecraft and the rocket at a cost of around \$55 million per passenger, said another report.

## 8.AI in SpaceX's mission

Little did you know this historic mission is powered by the cuttingedge technology of artificial intelligence, Yes! A sophisticated AI autopilot steers the cone-shaped Crew Dragon that is on its way to the ISS. Once the Crew Dragon reaches within 60feet of the space station, the astronauts will maneuver the vehicle to the ISS and remain in space for weeks on end, depending on when they are called back. In 2018 too, a SpaceX rocket flew into space with the first robot powered by artificial intelligence.

How AI powers space exploration AI helps analyze the huge amounts of data emanating from space exploration and this helps advance space exploration with each passing day. Moreover, AI is making it possible for rovers currently roving the atmosphere of Mars to take decisions independent of the mission. Data received from space is mainly in the form of images that are studied through machine learning techniques at the NASA Frontier Development Lab that has roped is the services of tech giants like IBM and Microsoft.

Infact, machine learning is helping in solar detection. storm damage atmosphere measurement, and determining the 'space weather' of a given planet through the magnetosphere and atmosphere measurement. Reports say the same technology is used in resource discovery in space. Moreover, AI applications "can optimize planetary tracking systems, enable smart data transmission, and nullify the risk of human error (by using predictive maintenance)," said this report. it's currently being utilised by a variety of industries, including-

## Healthcare

AI can mimic cognitive functions. This makes it a perfect fit within healthcare, where many issues need addressing to make treatments faster, more effective and more affordable.

One example of this is using artificial intelligence to build databases of drugs and medical conditions. This can help us find cures or treatment for rare diseases. AI is also being utilised to make healthcare more affordable around the world. The machine can mimic a doctor's brain, recognizing how humans express their ailments.

### Transport

Artificial intelligence is greatly improving the efficiency of the transport sector. It can help optimise routes, finding the fastest and safest journeys for different vehicles.

## Manufacturing

Adopting AI in different factories is helping to: -Make certain processes safer by automating them -Improve engineering efficiency

-Increase revenue

## **Global Navigation**

Data collected by Global Navigation Satellite Systems (GNSS) can support AI applications. Tracing, tracking, positioning and logistics are all areas that can be greatly improved due to precise and consistent data collection.

## **9.AI Applications in Space**

Applications of AI in the space sector are increasingly varied. As an example, one key use case lies in the management of satellites. By machine learning employing algorithms, organizations like the European Space Agency (ESA) optimize the functioning of satellite mega-constellations, which are pivotal for tasks such as Earth observation, communication, and space weather prediction.[1] AI systems are adept at processing the vast datasets these satellites generate and can perform analyses more rapidly and accurately than human analysts.

Across the Atlantic. NASA validated appropriate uses of AI capabilities in space activities all the way back in 2003 with the Autonomous Sciencecraft Experiment. Since then, NASA has begun to use AI for the daily operations of missions, such as the management of the International Space Station (ISS), managing crew, autonomous systems, and performing environmental science. Similarly, in more recent times, SpaceX has pioneered AI autopilot systems to dock their rockets with the ISS and land their reusable rocket stages, alongside deploying AI to coordinate collision avoidance maneuvers among their many Starlink satellites.

Leveraging the use of AI could also benefit missions on other celestial bodies as well, where it can power robots that autonomously navigate the Moon or Mars and extract oxygen from water .As we consider future deep-space exploration, AI will also help to resolve data downlinking issues, freeing up limited bandwidth for communication purposes.

### **10. AI in Indian space missions**

India too has been generating indigenous AI technology to power its space missions. Take for example its Chandrayaan-2 mission that was launched in July 2019. Scientists integrated AI technology with Chandryaan-2's rover – Pragyan. A report said, the Indian Space Research Organisation delivered Pragyan – a solar- powered robotic vehicle that was to explore the lunar surface on six wheels. Moreover, "the artificial intelligence algorithm could also help the rover detect traces of water and other minerals on the lunar surface."

### 11. Conclusion

AI and Space: Made for Each Other Over the last few years we have continued to see a large effort to commercialize space. Several companies are even looking to start tourist trips into space. Artificial intelligence is working to make space commercialization a possibility and to make space a safe environment in which to operate. The various benefits of AI in space all work together to enable further venturing into the unknown.

AI helps analyze the huge amounts of data emanating from space exploration and this helps advance space exploration with each passing day. Moreover, AI is making it possible for rovers currently roving the atmosphere of Mars to take decisions

independent of the mission. The NASA Curiosity rover can dodge obstacles on its route by itself and determine the best route possible. Data received from space is mainly in the form of images that are studied through machine learning techniques at the NASA Frontier Development Lab that has roped is the services of tech giants like IBM and Microsoft.

### 12. Future Scope

Machine learning is helping in solar storm damage detection, atmosphere measurement, and determining the 'space weather' of a given through the magnetosphere planet and atmosphere measurement. Reports say the same technology is used in resource discovery in space. Moreover, AI applications "can optimize planetary tracking systems, enable smart data transmission, and nullify the risk of human error (by using predictive maintenance)," said this report. There are so many other research going on implementing Artificial Intelligence in space exploration. Although, like other applications of AI, nothing can be secure and concrete. At the end of the day, we need human interventions in everything AI is capable of. With each innovation, AI is coming closer to providing newer insights and proving to be an advantage for humans in exploring the interstellar space with the innovative machine and project and researches.

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