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Generic Computing-Assisted Geometric Search for Human Design and Origins

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Abstract

Scientific space research aims to investigate human origins and provide explanation on how life originated on the earth. This has led to the emergence of theories such as the Panspermia theory. The Panspermia theory opines that life originated from extra-terrestrial sources. However, the Panspermia theory does not consider the influence of cognition and intelligence in microorganisms that are thought to seed life on the earth. However, it is feasible to consider intelligent microorganisms as determining the life-forms that can arise from different cell aggregations. This chapter considers that the pre-determination of the geometry of this feasible life-forms that takes place in Mars's meteorites. The discussion in this chapter proposes the Mars geometric Panspermia theory which is hinged on this perspective. The chapter presents the conceptual perspective for the Mars geometric Panspermia theory. It also presents network architecture and a data acquisition strategy suitable for capital constrained organizations. The capital constrained organizations are space organizations in developing countries. The low cost acquisition strategy proposes the use of open source software and hardware for components used in Mars exploration missions. In addition, the chapter proposes rover data sharing to enable capital constrained space organizations to execute their science objectives in Mars's space missions.

Keywords: human origins, computing search, light, design, computing resources

1. Introduction

The quest to understand human origins is a significant factor that propels the conduct of scientific research in space. This quest is been sustained by advances in space exploration technology. Advances in space exploration technology have made it possible to increase human understanding of the origins of the universe with improved ability to understand events such as the Big Bang. The Big Bang is considered to be the epoch that led to the beginning of the universe [1–3]. The emergence of the Big Bang theory has led to the necessity of conducting a search to find supporting evidence.

Besides, the quest to understand the evolution of the universe; there is also an interest in understanding human evolution. The concept of evolution has been considered to play a crucial role in the emergence of modern humans. Humans and the universe share a common trait in their emergence and continued existence. This

common trait is seen in the role that light plays in the role of the evolution of the universe and humans. The role of light is less appreciated in the evolution of humans than in the universe. This is because of the significant effort and the duration that has been invested in studying the role of light photons in the universe. The role of photons in a scientific study of the universe can be seen in domains such as optical astronomy [4]. Photons also play an important role in humans as seen in the existence of bio-photons [5–7]. Therefore, light has played an important role in human evolution too.

The notion created by the concept of the Big Bang as being the first event in the universe is that the universe first emerged and that humans appeared and evolved at a later epoch. The implication of this notion is that the existence of the universe is thought to precede human appearance and continued evolution. This does not consider the perspective that human evolution can have an extra-terrestrial influence. However, the alternative perspective presented in the Panspermia theory considers that human evolution has an extra-terrestrial influence. The incorporation of an extra-terrestrial influence on human evolution implies that evolutionary actions influencing the emergence of the universe and humans could have evolved at the same epoch. Such a perspective is supported by the Panspermia theory.

The Panspermia theory presented is of the opinion that life was seeded in outer space [8–11]. Though, there is an argument against the Panspermia theory [12], the theory should not be discarded. This is because of the possibility of the extinction of biological life in outer space making these challenging to observe in comparison to the ability to directly observe life-forms on the earth.

The discussion here proposes that the aggregation of life-forms leaves a geometric trace in outer-space. This perspective differs from the theory underlying the Panspermia theory that has motivated astrobiology research. The discussion in this chapter considers that the observation of life forms can be done from two lenses. These lenses are those of geometry traces associated with life-forms and that of biology. The consideration of the geometry traces associated with life-forms provides an opportunity to design a paradigm suitable for investigating the validity of the Panspermia theory from the geometrical perspective. The novel perspective being presented proposes that geometry traces associated with life-forms are present in the extra-terrestrial environment. These traces constitute the evidence of life originating from outer-space as advocated in the Panspermia theory.

The contribution of this chapter is twofold. The first contribution is that the chapter presents the Mars geometrical Panspermia theory as an alternative paradigm for investigating the emergence of humans. The Mars geometrical Panspermia theory advocates that geometrical traces emerging from different aggregation patterns of life forms are present in the meteorites on Mars. The aggregation is considered feasible because Mars can support simple life forms such as Bacteria.

The chapter's second contribution is the design of low cost network architecture for conducting Mars exploration missions aimed at verifying the Mars geometrical Panspermia theory. The low cost network is intended for use by space organizations in developing nations. These space organizations being considered are those with limited capital and limited space engineering capacities.

The remainder of this chapter is organized as follows. Section 2 discusses the background and existing work. Section 3 presents a mathematical framework describing the Martian geometric Panspermia theory. Section 4 describes the proposed Mars based geometric Panspermia theory. Section 5 focuses on the proposed low cost network architecture. Section 6 concludes the chapter.

2. Background and existing work

Mars has been considered as a suitable location that can be studied to increase human knowledge on the existence of extra-terrestrial life [13]. This is because Mars shows patterns of planetary evolution and climate change. Mars exploration is also appealing because Mars is accessible to Spacecraft launched from earth. Several research groups have been established aiming to engage in Mars exploration missions. Two research groups in this regard are the Mars Exploration Program Analysis Group (MEPAG) and the outer planet assessment group (OPAG).

Johnson et al. [14] discuss MEPAG's Mars exploration initiative. It is recognised that a successful Mars exploration campaign requires the development of technology across multi-disciplinary domains. The required technical capabilities comprise: (1) Mars surface access at different altitude and elevations, (2) Mars environment characterisation, (3) life detection and (4) age dating. Environment characterisation requires the dynamic evaluation of chemical and isotopic compositions at various locations on Mars. The realization of these tasks in a Mars exploration mission requires the design and launch of instrumentation on Mars rovers.

Mars exploration missions aim to analyse Mars's environment and probe its composition. The composition of Mars can be found in two types of records [13]. These are the chemical record and physical record. Each record targets the detection of a different type of bio-signature. The physical record refers to the analysis of the weather and climate in the environment of the planet Mars. The chemical record refers to organic compounds that enable the support of biological mechanisms in terrestrial life. In addition, deployed Mars exploration vehicles search for an evidence of a life supporting climate.

The detection of elements belonging to the bio-signature in either physical or chemical record requires the use of appropriate instrumentation. Suitable instrumentation is also required to obtain information from a Mars exploration mission. The choice of instrumentation technology is determined by the science case.

The discussion in [14] focuses on the components of a Mars exploration campaign. It presents a hierarchy of the objectives enabling the realization of the science goal for a Mars exploration mission. Though the role of advanced instrumentation is recognised; algorithms, theories and perspectives that can motivate the design of advanced instrumentation have not been presented.

The choice of instrumentation is also influenced by the sample return expected from a Mars exploration mission. Mars missions can be classified as Mars return sample missions and non-Mars return sample missions. The Mars return sample mission aims to deploy Mars vehicles that take samples from Mars and brings them to earth for further analysis. The sample(s) is the deliverable in the Mars return sample missions. Non-Mars sample return missions are those in which the deployed Mars vehicle aims to execute analysis on Mars and obtain results. The results are relayed to the earth via an integrated telecommunications system for further analysis.

The discussion in [13, 14] describes the objectives of the MEPAG in 2009. It is important to consider how changes in science case influence the instrumentation and the goals of Mars exploration missions. This is because of changing interests in the outer space exploration and how technology advancement influence Mars exploration missions. A change that has occurred in Mars exploration is an increase in the number of space agencies seeking to participate in Mars exploration missions [15]. Another change arises due to technological advancements leading to the use of small satellites in Mars exploration missions. The emergence of small satellites has

led to their use in Mars exploration missions. In this case, small satellite is dependent on the science case definition.

The outcomes of a space exploration for a defined science case can be classified into four categories [16]. These outcomes would be that the location or body in outer space is inhabitable, probably habitable, habitable and inhabited [16]. A motive to categorize any location as being described by any of these four outcomes is dependent on the science case and the instruments aboard the exploration vehicle. This can be seen in the case of the Europa Lander project aimed at surveying the Jovian moon, Europa [16]. The Europa Lander aims to determine the habitability of Europa and investigate its surface properties and dynamics. The instrumentation enabling the acquisition of Europa's samples aboard the Europa Lander are the sample ingestion port, and the context remote sensing instrument package.

The discussion in [17] extends [13–16] by raising the question of the utility that can be derived from Martian samples obtained in Mars sample return missions. The use of randomly acquired samples from Mars is insufficient to answer the queries as regards the origin of life on Mars and other locations such as the Jovian moon, Europa. The use of sample heterogeneity is thereby proposed. Sample heterogeneity refers to the acquisition of samples from different locations on Mars or in Europa. The incorporation of sample heterogeneity enables the acquisition of Mars samples from different locations on Mars. These samples are returned to earth for future analysis. The transport of samples from Mars to earth is done in such a manner that the contamination of earth by these Martian samples is prevented. The assurance that Mars samples pose no contamination risk to earth is handled by the space agency coordinating the Mars exploration missions. The National Aeronautics and Space Administration (NASA) is an example of a space agency that can play this role.

The study in [17] aims to study Mars's environment in the view of the M-2020 mission. The intended study is with the following aims. The first aim is analysing the geological processes (with emphasis on determining the role of water). The second is evaluating the biological history of Mars. The third is determining Mars's evolutionary timeline. The fourth is determining relations between components in Mars's geological system. The fifth is to acquire samples enabling the reconstruction of the processes that have influenced the Martian dynamo. The sixth is quantifying human risks associated with Mars exploration.

The discussion in [13–16] shows that bio-signatures are important for the conduct of outer space missions searching for evidence of extra-terrestrial life. The search and successful detection of bio-signatures are important for Mars exploration missions [13–15] and the Europa Lander project [16]. The category of bio-signature being sought influences the composition of the deployed instrument payload. The approach in [13–19] assumes that a planet or outer space location where the evidence of life is being sought must have bio-signature(s). Therefore, the search for extra-terrestrial life in the environment of outer space is hinged on the existence of the bio-signature.

However, bio-signature existence in outer space locations is threatened because space exploration vehicles can be contaminated with microbes. This contamination can take place on earth prior to launch. The resulting contamination can cause the deployed instrumentation payload to detect earth originating microbes or microorganisms in outer space. This leads to a wrong conclusion as regards the detection of extra-terrestrial life. In addition, such planetary contamination could render a given location or body in outer space infeasible for searching for extra-terrestrial life. Therefore, planets should be protected against microbial contamination. This concern has led to the emergence of planetary protection.

Bio-signature preservation is important for the success of detecting extra-terrestrial life in Mars exploration missions. The detection of bio-signatures can be used to determine the absence or presence of life on Mars in Mars exploration missions [20]. Hays et al. in [20] note that the presence of bio-signatures and their subsequent detection is important for the success of Mars exploration missions. It is also important to ensure that Mars missions preserve existing bio-signatures that can be found on Mars.

The preservation and improved understanding of bio-signature can be achieved by using Analog terrestrial Mars environments. Hays et al. [20] recognize the usefulness and suitability of Analog terrestrial Mars environments. Analog terrestrial Mars environments enable the conduct of low cost investigation for the presence of life on Mars. The use of analog terrestrial Mars environments enables scientists to understand relations between different bio-signatures. This is important in determining the cues to be searched for in Mars exploration missions such that planetary contamination is prevented.

Moreover, the use of analog terrestrial Mars environment enables developing nations to participate in Mars exploration studies. In this role, analog terrestrial Mars environment can be used as low cost alternative prior to actual outer space exploration. This helps developing nations in making better decisions as regards achieving planetary protection. However, this has not been explored in [20].

The potential bio-signatures that can be detected in a Mars exploration mission are dependent on the defined science case. Six classes of bio-signatures have been identified by the Mars 2020 science definition team [20]. These are organic molecules, minerals, macro structures, chemistry and isotopes. The detection of any potential bio-signature in a given class enables the realization of the objectives of an outer space project investigating the occurrence of extra-terrestrial life.

The critical role that bio-signatures play in Mars exploration missions makes it important that bio-signatures are protected from threats to their continued existence. This concern is recognised in [20, 21]. The need to protect bio-signatures has led to the need to design planetary protection strategies to protect Mars from bio-signature contamination. It is recognized that Mars environment provides some native protection to prevent the total erasure of bio-signature, i.e., bio-signature contamination.

The protection capability of planetary protection strategies can be enhanced by enacting policies matched with technological developments. These technological developments ensure bio-signature preservation. Inter-planetary protection is needed in two roles. These are the forward prevention role and the backward prevention role. In the forward protection role, planetary preservation and contamination preservation ensures that microbes are not taken from earth into Mars. The backward preservation role is important for Mars sample return missions. It ensures that samples being brought from Mars are not contaminated on their way to the location where further analysis will be carried out [10].

The forward protection role can be realized by sterilizing Mars exploration vehicles. Sterilization of Mars exploration vehicles ensures that the search for extra-terrestrial life is not compromised by earth originating microbes [22]. Sterilization also ensures that disease causing microbes are not brought to the earth by Mars exploration vehicles in Mars sample return missions.

However, planetary protection strategies are rarely ideal and a 100% protection is not readily achieved. In addition, planetary protection procedures are expensive and influenced by the science case associated with a Mars exploration campaign [22]. The non-ideal performance implies that the chance of detecting pristine bio-signatures might be slightly diminished. Therefore, the non-ideal performance of planetary protection via sterilization constitutes a source of interference to

bio-signature detection. The effect of interference as observed here also affects the conduct of radio astronomy in the form of radio interference. This has received attention [23, 24]. The interference challenge posed by non-ideal sterilization can be addressed by finding another marker that can signify the presence or occurrence of life in Mars. This is important to ensure the realization of Mars exploration mission.

3. Mars geometrical Panspermia theory: concept and analysis

The discussion in this section presents the human evolutionary perspective and origins of the universe as being considered in the proposed Mars geometrical Panspermia theory. The discussion in this section is divided into two parts. The first part presents the underlying concept in the proposed Mars geometrical Panspermia theory. This part considers geometry as being associated with the activities of organics describing the aggregates of cell components. The geometry associated with activities leading to the aggregates of cells is considered as the bio-signature of interest. The second part presents the mathematical framework that describes the model of the proposed Mars geometrical Panspermia theory.

3.1 Underlying concept: Mars geometrical Panspermia theory

The Mars geometry Panspermia theory is of the perspective that the emergence of life was a multi-stage process. This multi-stage process ends in the aggregation of life forms leading to the emergence of first humans. In addition, the multi-stage process is considered a procedure in both lithopanspermia and radiopanspermia and other forms of life transfer mechanisms considered in the Panspermia perspective.

The current perspective being considered in the concept of Panspermia is to search for microorganisms such as Bacteria in locations in spatial objects such as comets and meteorites [25]. For example, Wickramasinghe et al. [25] point out evidence that bacteria similar to terrestrial bacteria can be found in the stratosphere and low earth orbit at the international space station. The discussion opines that more actions leading to the emergence of life besides that of bacteria take place in space. The set of actions in this context have a cognitive component and provide the first form of intelligence. The implied intelligence influences the multi-stage process during which the aggregation of life forms take place.

The intelligent pre-determination of the aggregation pattern of life-forms. This aggregation does not occur on earth but leaves a trace behind in the universe. These traces are considered by the proposed Mars geometry Panspermia theory to exist on Mars meteorites. The multi-stage process is considered to be intelligent. The invoking of an intelligent process does not contravene the principles of scientific reasoning and logic. In this case, the invoking of intelligence constitutes the hypothesis for the research being presented.

Given that intelligence is present as argued; such intelligence must have influenced the process and pattern of initial life-form aggregation. The initial aggregation pattern presents a base for the principles of evolution to act in the organism or life-form at a later epoch. A notion of such intelligence can be found in [26]. The consideration of the intelligence in this chapter is intended to make a contribution to the domain of general intelligence and space science research. General intelligence in this context includes biologically inspired artificial intelligence. The concept of the presence of intelligent design requires a test procedure to establish its existence. Such a procedure would help to validate the Panspermia theory.

3.2 Mathematical framework: Martian geometric Panspermia theory

The discussion here presents a mathematical model for describing the model of the universe as presented in the proposed Martian geometric Panspermia theory. The mathematical model considers the universe as comprising multiple locations, life conveying locations, life conveying material or mechanisms (or other life forms), life supporting locations, and life recording locations.

Life supporting locations are those locations where the conditions exist to support the presence of extra-terrestrial life. Let \mathcal{S} , ζ and \ddot{Y} denote the set of (i) Life conveying locations, (ii) Life conveying mechanisms aided by micro-organisms and (iii) Life recording locations in the universe respectively.

Life conveying locations in this context refer to locations on Mars where meteorites to be ejected at a later epoch are located. Life conveying mechanisms describe the dynamics and processes ensuring the movement of ejected meteorites from Mars to earth. This is realizable while maintaining micro-organism composition in ejected meteorites. Life recording locations are those locations where the proof of the existence of extra-terrestrial life can be found.

$$\mathcal{S} = \{\mathcal{S}_1, \mathcal{S}_2, \mathcal{S}_3, \dots, \mathcal{S}_A\} \quad (1)$$

$$\zeta = \{\zeta_1, \zeta_2, \zeta_3, \dots, \zeta_B\} \quad (2)$$

$$\ddot{Y} = \{\ddot{Y}_1, \ddot{Y}_2, \ddot{Y}_3, \dots, \ddot{Y}_F\} \quad (3)$$

Life can be conveyed from location \mathcal{S}_a ; $\mathcal{S}_a \in \mathcal{S}$ to locations \mathcal{S}_{a+1} ; $\mathcal{S}_{a+1} \in \mathcal{S}$, \mathcal{S}_{a+4} ; $\mathcal{S}_{a+4} \in \mathcal{S}$ and \mathcal{S}_{a+7} ; $\mathcal{S}_{a+7} \in \mathcal{S}$ via life conveying material ζ_b ; $\zeta_b \in \zeta$ and ζ_{b+1} ; $\zeta_{b+1} \in \zeta$. For the purposes here, the locations \mathcal{S}_{a+1} , \mathcal{S}_{a+4} and \mathcal{S}_{a+7} \mathcal{S}_{a+2} ; $\mathcal{S}_{a+2} \in \mathcal{S}$, \mathcal{S}_{a+3} ; $\mathcal{S}_{a+3} \in \mathcal{S}$, \mathcal{S}_{a+5} ; $\mathcal{S}_{a+5} \in \mathcal{S}$ and \mathcal{S}_{a+6} ; $\mathcal{S}_{a+6} \in \mathcal{S}$ are life supporting locations. The location \mathcal{S}_a is called the root location.

The locations \ddot{Y}_f ; $\ddot{Y}_f \in \ddot{Y}$; \ddot{Y}_{f+1} ; $\ddot{Y}_{f+1} \in \ddot{Y}$; \ddot{Y}_{f+2} ; $\ddot{Y}_{f+2} \in \ddot{Y}$ act as life recording locations in the universe. They contain evidence of the action of life transfer process mechanisms by different micro-organisms. The action of life transfer by different micro-organisms is considered intelligent. Such a notion is supported by the evidence of intelligent behaviour in bacteria [27–29].

The notion that bacteria and microorganisms exhibit intelligent behaviour has received considerable interest [27–29]. The intelligent behaviour exhibited by microorganisms has been thought to evolve in response to surviving in their host environment. Intelligence requires the ability to act on information obtained from the environment. The capability to demonstrate intelligent behaviour implies that microorganisms can respond to environmental conditions from a base of stored information [27]. Therefore, it is feasible to think that microorganisms are capable of storing information.

It is inefficient for microorganisms to store all information relating to the processes in which they are engaged if all of such information is not required to develop survival strategies. An important piece of information that is considered not to be stored by the microorganism is those related to the pre-determination of geometrical forms of cell aggregation patterns. The storage of the information on the pre-determined geometrical forms is considered to increase micro-organism information overhead. Hence, it is not stored so that the microorganism can have high information storage and processing efficiency.

A scenario showing the relations between life recording locations, live conveying mechanisms and the earth is presented in **Figure 1**.

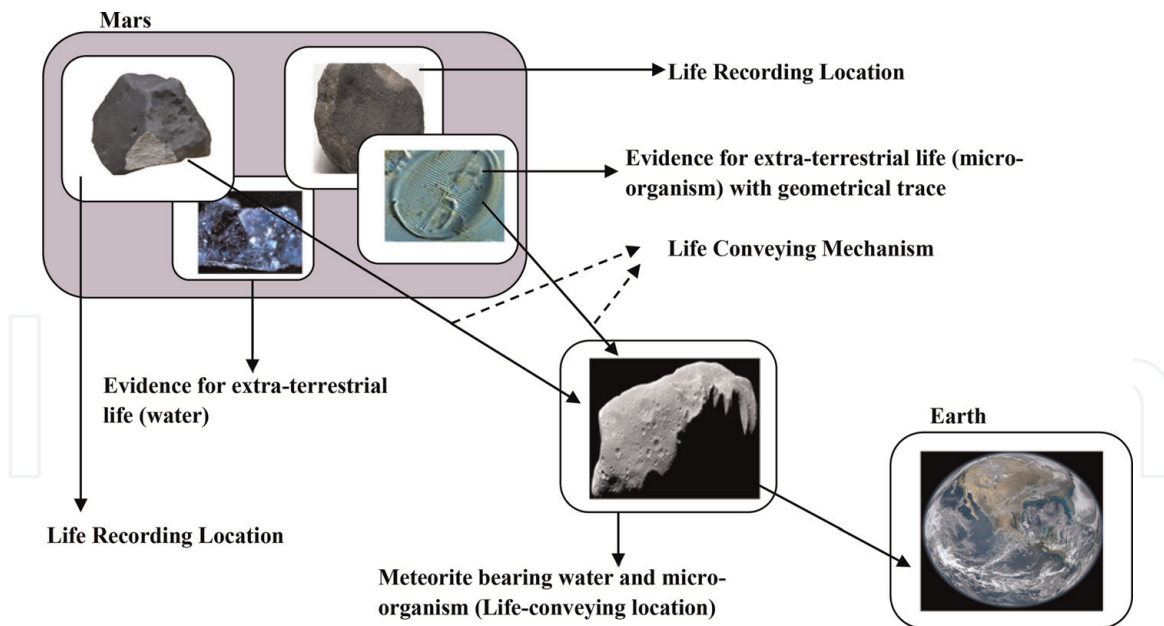


Figure 1.
Relations between life recording locations, life conveying mechanisms, Mars and earth as proposed in the Mars geometrical Panspermia theory.

4. Proposed Mars geometric Panspermia theory: verification

The Mars geometry Panspermia theory being proposed opines that geometric form pre-determination precedes the appearance of life-forms on earth. The geometric form pre-determination process is considered to leave behind traces in the planet Mars. The usage of the term pre-determination is intended to depict the execution of action(s) related to geometric form pre-determination at an epoch prior to the appearance of earthly life. The earlier epoch being implied here occurs on the planet Mars. The pre-determination process is considered to leave traces in Mars and specifically in Mars's meteorites. These traces are in the Mars's meteorites and can be discovered by the process of scanning Mars.

In the proposed Mars meteorite scanning, Mars's meteorites are considered to deliver the functionality of life conveying locations and that of the life recording locations. This is because Mars's meteorites have been found on the earth while other meteorites remain on the planet Mars. Meteorites from Mars have been found to have traces of life from Mars's environment as seen in [30].

Worth et al. in [31] opines that Mars's meteorites play an important role in lithopanspermia. They point out that some Martian meteorites have been suspected to have organic bio-markers. In [31], rock exchange between planets is theorized and considered to play an important role in inter-planetary life seeding and transfer. However, the discussion focuses on the rock (meteorite) transfer process as being responsible for the propagation of life throughout the universe. It does not consider the underlying process that has motivated the emergence of the different life forms that can be found on Mars's meteorites. This is because [31] have focused on the transfer mechanisms and details of the rock transfer process such as transfer rates.

Steffen et al. [32] share the same perspective with Worth et al. [31] and consider that life conveying biological material may have been exchanged between planets. The planets being considered exist in a multi-habitable system. Steffen et al. [32] recognise that the consideration of a multi-habitable system has implications on the propagation of life within the solar system and also outside the solar system. The

focus in [32] is on analysing the ejection mechanics and dynamics associated with exchanging life conveying biological material between planets.

The research focus on the Panspermia theory as seen in [31, 32] considers that life is propagated throughout the universe (within the solar system and outside the solar system). The focus has been on analysing the dynamics and investigating the relations between planets to enable life transfer to the earth. Mars has been widely considered as a planet from which life was seeded to the earth [10, 31–35]. The discussion in this chapter opines that the microbes and micro-organisms involved in the Panspermia life transfer process engage in different computational tasks. The execution of these computational tasks is considered feasible because earth based microorganisms such bacteria have been observed to engage in computational behaviour. This has led to the emergence of research in bacteria computing [36, 37].

In the discussion here, the Panspermia theory is considered to include the computational activities executed by microorganisms on meteorites sited in Mars. The evidence of such computation occurring on Martian meteorites is observed by Mars rovers and transmitted to the earth via a communication network.

Mars's meteorites play an important role in the Panspermia theory. They provide an environment enabling the interaction of microorganisms with astro-materials. Therefore, the meteorites can be considered as life recording locations. The ability of meteorites to move from Mars to earth motivates their consideration as life conveying locations. In the proposed Martian scanning, meteorites that are life recording locations are based on Mars. These meteorites are scanned within the Martian environment. The results from the scanning process are used to verify the proposed Martian geometric Panspermia theory.

In the proposed Mars geometric Panspermia theory, the geometry associated with life-form aggregation is considered to be determined via a native microorganism optimization computation procedure. The optimization procedure aims to determine the geometry of different life-form aggregations. The geometry being implied is described in the two dimensional and three dimensional representations of different life-forms. The dimension of the geometry being considered is in the range of nanometers to millimeters.

The Mars scanning procedure is executed using Mars rovers and Mars based transceivers. The Mars rover hosts data storage payload that hosts multi-spectral, multi-angular and high resolution images of different life-form aggregation.

In addition, the Mars rovers hosts payload that can detect geometry of life forms with pre-defined dimensions. In this case, the dimension lies in the range of nanometers to millimeters. The Mars based transceiver transmits the detected results (from the Mars exploration mission) to earth via a communication network. The communication network receives results from the Mars rovers via the Mars based transceivers and sends it to an earth station. The scanning procedure is executed in a distributed manner. The geometrical forms are obtained in two dimensional and three dimensional representations. The geometrical forms are transmitted to an earth station via a communication network. Each Mars rover is pre-loaded with geometrical forms of different life-form aggregations that can be found in earth based life forms.

Let θ_1 and θ_2 denote the set of geometrical forms on images in the Martian rover and geometry of aggregates of different life-forms in Mars's meteorite respectively. A match is considered to occur if $(\theta_1 \cap \theta_2) \neq \emptyset$. The verification of the proposed theory takes place in the following steps:

1. **Initial cell aggregation image generation**—This stage enables the generation of high resolution images of different aggregates of different life forms. The

process takes place on earth and allows the two dimensional and three dimensional representations of cell aggregates to be uploaded on the Mars's rovers intended for launch. The images obtained are stored and processed prior to being uploaded to the Mars's rover intended for launch from earth to Mars.

2. **High resolution image distribution**—This stage enables the generated two dimensional and three dimensional images to be uploaded on Mars's rovers intended for launch. The images to be uploaded to each Mars based rover will be influenced by the objectives of the Mars exploration mission. The exploration mission is focused on detecting geometrical patterns of aggregates of different life forms. The stage of high resolution image distribution is executed prior to the launch of rovers to Mars.
3. **Computational stage**—The computation requiring the execution of the image comparison takes place aboard the Mars based rover. The image comparison algorithm aims to verify if the condition $(\theta_1 \cap \theta_2) \neq \emptyset$ or $(\theta_1 \cap \theta_2) = \emptyset$ holds true. The proposed Mars geometric Panspermia theory is verified to hold true if $(\theta_1 \cap \theta_2) \neq \emptyset$. In this case, the Mars rover stores the outputs of the image compression procedure for the concerned Mars based meteorite and geometry of life form. The outputs of the image compression process are the (i) Binary comparison indicator, (ii) Mars's meteorite ID and (iii) Stored geometric form ID. The binary comparison indicator has a value of zero if $(\theta_1 \cap \theta_2) = \emptyset$ and a value of one if $(\theta_1 \cap \theta_2) \neq \emptyset$. The Mars's meteorite ID is the name that is commonly used to refer to Mars's meteorite. The geometric form ID is a numeric index that is assigned to a high resolution image being uploaded to the Mars rover.
4. **Computational algorithm update stage**—The computational algorithm update stage enables the image processing algorithm on the Mars based rover to be updated. This is necessary to continuously improve the result of the scanning process and prevent technology obsolescence. The update is executed by transmitting algorithms for improved image comparison and comparison results processing. The transmission that enables the execution of the update is received by the data storage payload which is connected to the Mars based transceiver. The Mars based transceiver receives the update information from communication satellites that receive the forwarded data from earth orbiting communication satellites which communicate with the earth station.

The relations between the stages of initial cell aggregation generation, high resolution image distribution, computational stage and computational algorithm update stage is shown in **Figure 2**. The scenario in **Figure 2** shows the process of executing the stages involved in the Mars geometrical search procedure. The cell aggregation generation procedure is executed on earth by acquiring high definition images of life-form aggregates in an earth based database. These high definition images are transferred from the database to the open source ground station entity. The open source ground station transmits the images and the geometrical outline information to the Mars based storage payload (with integrated transceiver). The images are transmitted from the storage payload with integrated transceiver to the Mars based rover via an upload process. The process scanning meteorites on Mars begins after uploading to the Mars based rover.

A bidirectional link exists between the Mars based rover and the storage payload with transceiver. The existence of the bidirectional link also enables the computational results from the Mars based rover to be sent to the storage payload with

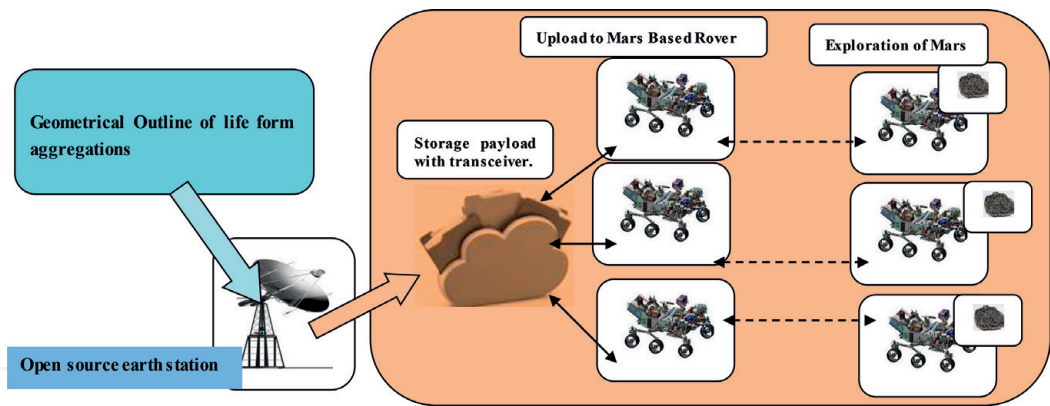


Figure 2.
Relations between the earth entities and the Martian entities in the proposed Martian geometrical search.

integrated transceiver. The existence of a bidirectional link between the storage payload with integrated transceiver and the open source earth station also allows the computational results to be accessible to the capital constrained space organization.

The computational algorithm used to execute the operation in $(\theta_1 \cap \theta_2)$ is an artificial neural network.

The artificial neural network is developed on the earth prior to launching the Mars based rover. It is trained with the high resolution images of different geometric forms for different cell aggregates, i.e., tissues and organs. This encodes the geometry of the high resolution images in the artificial neural network. The developed artificial neural network is installed on the data storage payload before launch. The artificial neural network is trained to receive geometrical forms from Mars meteorites as input. The predicted output of the artificial neural network is the value of the binary comparison indicator.

5. Network architecture

The successful execution of the computational procedure and transmission of computational result requires the availability of supporting network architecture. The design of network architecture should consider the preferences and resources available to the concerned space organization.

In this chapter, space organizations are considered in two categories. The first kind of space organization is that of a developed and technologically advanced nation. Examples of such space organizations are the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA). These space agencies have access to significant amount of resources to conduct interplanetary space missions. The first kind of space organization has resources to undertake Mars exploration missions aimed at verifying the proposed Mars geometrical Panspermia theory.

The second kind of space organization is that of a developing nation. Space organizations in this category do not have access to significant amount of resources required to conduct interplanetary space missions. However, this does not necessarily hold true for space agencies in the second category. The scarcity of resources in developing nations limits their ability to realize Mars communication networks. The network architecture being proposed is intended for use by space agencies in the second category.

The proposed network architecture comprises two entities. These are the ground based entity and the space based entity. In the proposed network, communications

is bidirectional. The downlink communications involves the transmission of information from Mars to earth. The uplink communication involves the transmission of information from earth to Mars.

The ground based entity comprises components such as earth stations, data processing and computing sub-entity (DPCE), communication payload re-configuration sub-entity (CPCE). The earth stations relay information to a Mars based data storage payload. The Mars based data storage payload hosts updated information on high definition two dimensional and three dimensional images of life-form aggregates. The high definition images show the geometry of the concerned life-form aggregates. The Mars based data storage payload receives information from a Mars orbiter.

The DPCE is a ground based entity owned by the space organization in a developing country. It aggregates the high resolution images of cell aggregates from different sources. In addition, it hosts the high resolution images of cell-aggregates. The content of the DPCE is dependent on the science mission of Mars exploration. In the case where geometrical forms of humans are being sought, the DPCE's contents are high resolution images of cell aggregates of humans. The DPCE's contents are transferred to the Mars based data storage payload via a network of ground stations or communication satellites.

The CPCE enables the configuration of the communication payload that links the DPCE to the Mars based data storage payload. It co-ordinates and monitors the process of data transfer between the Mars based data storage payload, Martian rovers and the DPCE. The DPCE communicates with the Mars based data storage payload via open source ground stations.

The use of open source ground stations is suitable for capital constrained space organizations in developing countries. In the proposed model, space organization seeking to execute Mars exploration missions can make use of open source ground stations with expansive global coverage. This approach is feasible due to the development of open source software [38] and open source hardware [39–41].

However, the use of open source hardware and software approach has not been widely considered in developing components for Martian missions in developing nations. The use of open source paradigm is beginning to gain recognition for space exploration and satellite applications. Examples of open source initiatives for developing satellites are Kubos [42], NASA Virtual ADAPT [43, 44], and the open satellite project [45]. The examples in [42–45] have focused on development of open source satellite software. In this regard, space exploration and technology has adopted the open source software development approach. The open source approach has also been considered for developing satellite hardware. The UPSat initiative is an example of a case where open source approach has been used for satellite hardware development [46, 47]. This initiative is sponsored by the Libre space foundation [48]. The Libre space foundation aims to create open source space technologies for future space applications. The organization is also playing a leading role in the development of open source satellite earth stations in its satellite networked open ground station (SATNOGs) initiative. The SATNOGs initiative intends to make the development of the ground and space segments of a satellite network open to the public. It comprises crowdsourced satellites whose information is held in a database [49].

The space organization with insufficient capital and in a developing country can access the type of database in [48] to determine if it can communicate with a Mars based transceiver. The output of this procedure is a ground station or multiple ground stations that can be used to communicate with the Mars based transceiver. This communication can be used to realize Mars rover data sharing between technologically advanced and non-technologically advanced nations.

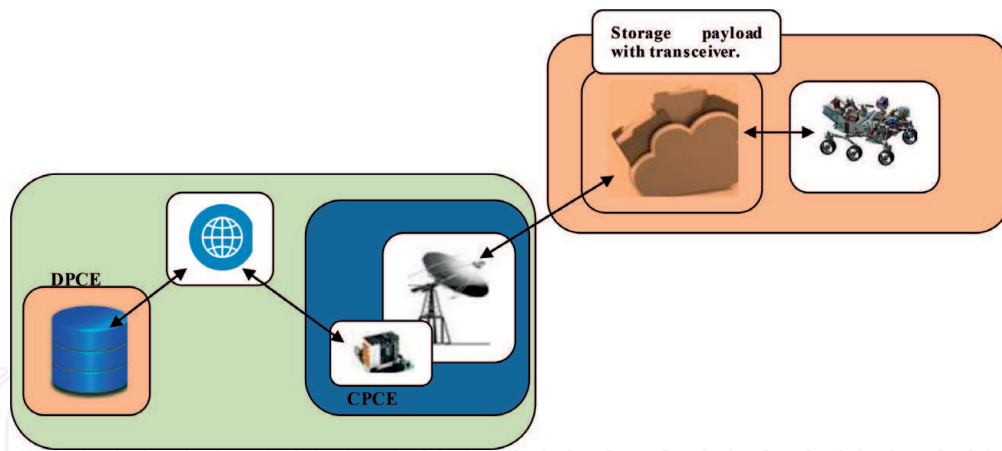


Figure 3.
 Relations between earth based and Mars based entities involved in the Martian geometrical search paradigm.

The network architecture showing the role of the DPCE, CPCE and Martian based transceivers is shown in **Figure 3**. The scenario in **Figure 3** shows the case where a capital constrained space organization with one DPCE having access to one earth station from the open source ground station network.

In the network architecture shown in **Figure 3**, the DPCE communicates with the CPCE (an SDR) via an internet call. The internet call enables the transfer of images and geometrical forms from the DPCE to the CPCE. The CPCE has reconfigurable and temporal data storage capability. The CPCE enables the earth station to transmit the data to the Mars based storage payload with integrated transceiver.

The network architecture can be implemented by a single nation or either multiple nations. The concerned nations are those with capital constrained space organizations. The use of open source ground stations for a given time to transmit data to Mars. The capital constrained space organizations make use of the open source ground station antenna for a given time. The scenario presented in **Figure 3** assumes that the capital constrained space organization is able to afford the design, production and launch of the Martian rovers.

However, the costs of designing and launching a rover to Mars can easily approach tens of billions of dollars thereby overwhelming the economic capability of developing countries. For example, the cost of developing Curiosity approaches USD 2.5 billion. The cost of launching multiple rovers increases beyond the financial capability of developing nations. Nevertheless, capital constrained space organizations need to be able to investigate the Martian geometrical Panspermia theory.

The discussion here proposes the concept of Martian rover data sharing. In Martian rover data sharing, the data obtained by a Martian rover owned by a technologically advanced nation is shared with capital constrained space organization. The sharing is done without disrupting the scientific objective of the technologically advanced nation. The sharing is unaffected by power limitations because the concerned Mars rover is nuclear powered.

6. Conclusion

The discussion in this chapter presents a new perspective in investigating human origins. The new perspective is called the Mars geometry Panspermia theory. However, the new perspective opines that the emergence of human life was preceded by pre-determining the geometry of different life forms aggregate. The evidence for

this intelligent task exists as a geometrical record on Mars's meteorites. The chapter also proposes a low cost network architecture that aims to verify the Mars geometry Panspermia theory. The proposed architecture searches Mars's meteorites for geometric patterns of different life-forms aggregations. It also incorporates Mars rover data sharing enabling space organizations in developing nations to access the acquired data and also investigate the Mars geometrical Panspermia theory.

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