The Search for Extra-Terrestrial Intelligence

The Flying Saucepans

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Introduction

Since the beginning of time, humankind has looked up at the stars and wanted to explore them. In more recent times, scientists have gazed up at galaxies with high-powered telescopes and wondered what other kinds of intelligent life might exist out there. This exploration of space and the search for extra-terrestrial intelligence is driven by the power of computers and computer science. Without computers, there would be no rovers, no computer models of other planets, no high-powered telescope and satellite arrays to scan the frequencies for communications from aliens. Through humankind’s knowledge of geometry and math, we can use computers to estimate distances to far-away stars. Through our understanding of our own biology, we can guess where to look for other intelligent beings and even guess what they might look like or eat. Computers allow humankind to imagine extra-terrestrial with more creativity and more accuracy. They might even help us find them one day!

Unmanned Space Vehicles

ExoMars, planned to take off May 2018, is an unmanned spacecraft sent by the European Space Agency (ESA). The ExoMars project is hitching a ride on another rover sent by the National Aeronautics and Space Administration (NASA). NASA’s probe’s goal is to study Mars rocks for preserved life. This task will be accomplished using a coring tool. After finding a few dozen rocks from areas around the landing site, these samples are put into canisters. These canisters will be stored in a safe place for later pick-up, by a “Fetch” rover, whose mission is still being planned.

The Russian Phobos-Grunt rover was programmed to collect samples from a moon of Mars.

Source: www.space.com/13870-russia-phobos-grunt-spacecraft-life.html
Space probes are different from remote-controlled rovers or space shuttles. Instead of having a person controlling them, they are programmed to run on their own. Here’s a pseudocode example: if right bumper hits, then go backwards and turn left. A problem with probes is if it comes into contact with something it’s not familiar with, it could possibly destroy itself. Programmers have to be careful to prepare the robot for many situations.

A hybrid model, a remote-controlled rover and a space probe put together, could be move useful than any general space probe. In these spacecraft, the probe does the regular avoiding rocks and other items, but in more difficult tasks, such as launching other probes, it relies on radio signals from Earth. This is tricky because sometimes it takes a long time to relay to a probe on, say, Saturn and back- that would take approximately forty-eight minutes!

**Modeling**

Computer modeling is using a computer to model the likelihood of possible situations working out if you do different tests/things. In primary function of computer modeling, you create a scenario, then go back and change a detail to evaluate the outcome. It’s like a simulation of a real or imaginary world that can be altered using computer modeling.

The Search for Extra Terrestrial Intelligence (SETI) is the science of using radio, optical sensors, and telescopes to search for alien civilizations. SETI started in 1959 with the publication of a paper in the British journal *Nature* by Giuseppe Cocconi and Philip Morrison. They decided to explore the existence of alien civilizations and how they might be detected. It was their opinion that radio waves were the best method for detecting this.

NASA’s research involves looking for clues by creating virtual planets that interact with other planets and stars. Hundreds of planets have been discovered, most of which are gaseous and unable to maintain life. As more and more rocky-surfaced planets are discovered, computer
modeling can be used to determine the planet’s features. These features include temperature, magnitude of gravity, the air/atmosphere/oxygen level, soil content, and climate.

When you model a planet on a computer, you need to consider human needs to survive on a planet. Food is an obvious human need. Humans need food for the energy to grow and function daily. Humans also need oxygen to get energy from nutritional sugars. Nutrients from food build nails, skin and hair and help mend bones and organs. Water, another human need, allows these nutrients to circulate through the body and helps regulate body temperature. Keeping bodies at a moderate temperature maintains water in its liquid state in our bodies at all times. Finally, gravity allows human biological systems to properly function. When considering a new planet, we have to take into account all these essential needs, and we also have to protect ourselves from poisonous gases and radiation from the sun. Toxic gases and radiation can cause cancer, disease, and damage to the body.

Now, you’re probably wondering why in the world any of this would matter. Well, remember that through NASA’s efforts in computer modeling, we are now discovering more and more planets possibly suited for life as we know it. How could we discover these planets and analyze possible outcomes without computer modeling? With the new technology being formed today, we might someday just discover a second earth!

**Habitable Planets**

There are all different kinds of technology being used to find if planets can harbor earth-like life forms. For example, Argentinian researchers have invented a microbial fuel cell that could be used to find life forms by means of metabolism, or an energy source. Scientists don’t use something that would only detect carbon, though. Most life forms on Earth are carbon-based, but there is actually one life form on Earth that is nitrogen-based, something scientists didn’t think was possible before they made this discovery. To detect an alien metabolism,
researchers embed an anode, or a device that electric current flows through and into an electric device, in the substance to be studied (i.e. Martian soil). They then use protons and neutrons to create a circuit, and depending on how strong the current is, they can tell if life forms exist in the substance or not. Scientists also use technologies to detect visible and infrared light reflecting off of a planet. Chemicals absorb certain wavelengths, and depending on how much of the spectrum is missing, they can tell which chemicals make up the atmosphere of the planet, and therefore if the planet can support life. Remember Tatooine from Star Wars? NASA has even found planets just like that orbiting double suns! Unfortunately, the planet they found is actually cold, gaseous, and probably doesn’t harbor life.

Searching for planets is easier than ever with new technologies. Using powerful telescopes like Kepler, astronomers can search for stars with variations in the light emitted and find out that there is a planet orbiting there, blocking a little bit of the light from the sun. You can even go to planethunters.org and try it yourself! Cool, right?

An earth-like planet would need to orbit a sun at a certain distance to have liquid water and be the right temperature for earth-like life.

Source: www.nasa.gov/kepler/

Kepler

Imagine a day when thousands of people watched as streams of fire lit up the night sky. Then, imagine those streams depositing a telescope that would look for little green
men on other planets. If you can imagine that, then you are seeing Kepler, NASA’s alien-
finding telescope, burst into space on March 6. The Kepler Project has many parts, including
processing the never-ending stream of data and finding the planets in the first place.

On March 6, 2009, Kepler was launched with a Delta II rocket from Cape Canaveral,
Florida. Its mission is to find earth-like planets that could support life. So far, Kepler has looked
at over 100,000 stars to see if there are planets orbiting them. Kepler monitors any change in
light, and if the change happens regularly, scientists at NASA can deduce that a planet is
orbiting this star. For an earth-sized planet orbiting a star, the change in light is less than 1/100
of 1 percent. That’s equivalent to detecting a bug crawling on your car’s headlights from several
miles away. Now that’s pretty small! Then, the scientists use a type of telescope that make the
Fraunhöfner lines appear. These colors or color spectrum are used to see which colors are
being absorbed, and those smart people at NASA know which chemicals absorb which color of
light. Using this information, they can figure out the chemical makeup of the planet they’re
looking at to see if it’s inhabitable. Some of the things they are looking for are water, carbon
dioxide, an atmosphere and oxygen. A plane with a chemical makeup like ours, has a “golden
thumbprint”. Usually, scientists are ecstatic to find out if there is a possibility that bacteria can
live on a planet.

First, data are downloaded from the spacecraft through the Deep Space Network. The
Mission Operations Center at Laboratory for Atmospheric and Space Physics (LASP) receives
the data in radio waves and sorts them into files by the type of data. The data are then sent to
the Data Management Center at Space Telescope Science Institute in Baltimore, Maryland
(STScI), where they are archived. The data are then expanded, sorted by how long or short
they are, and if the pixels are target, background, or parallel with another. They are then
converted to Flexible Image Transport System (FITS). At this point in processing, the data are
labeled original. The data are then sent to the Science Operations Center at NASA Ames,
where detailed analysis is performed. The data are then returned back to the Data Management Center to be filed away. This process usually takes four months.

A planet at an earth-like distance from its star is in the stars *habitable zone*, where temperatures are just right for liquid water to not freeze or evaporate away. On Earth, a liquid ocean is needed for plant and animal life. This knowledge is important for what we’re looking for when we are searching for extra-terrestrials.

Last year, Kepler found its first inhabitable planet: Kepler 22b. The star it orbits is smaller than our Sun, dimmer (it’s only 4256.6 Fahrenheit while the surface temperature of the Sun is about 10000.4 F), and Kepler 22b orbits 15 percent closer to its sun. Since the star is smaller, it takes less time to orbit around it sun, about 209 days versus 365 days for our Earth. Kepler 22b is one of the 2,326 planet candidates that Kepler has found. Right now, it looks like one of the best candidates for alien life.

**Measuring Distance**

Scientists use many different units to measure distances in space depending on what is to be measured. For distances within our solar system or in other solar systems, *Astronomical Units*, or AU, would be used. An Astronomical Unit is the distance between the Earth and our Sun. For most other things, a *parsec* (pc) would be used. The parsec is the most commonly used unit for measuring distance in space. *Kiloparsecs* (kpc) would be used for distances within our galaxy or in other galaxies, and *Megaparsecs*, (mpc) would be used for distances between galaxies and in cosmology. When studying a smaller object, you would use kilometers. For the tiniest dust grains, you might use bemicrons, which are 1/1,000,000 of a meter! When a scientist compares objects, they might say, “its radius is 6 solar radii”, which means that something is 6 times the size of our Sun. For galaxies, people compare them with the Milky Way. Astronomers only use light-years for a unit when they are talking to the general public or teaching a class.
Parallax requires knowledge of the size of Earth’s orbit and measurement of the parallax shift.

Source: http://www.windows2universe.org/kids_space/star_dist.html

Astronomers use a method called parallax to measure the distance between two stars less than a few hundred light-years away. The parallax is when stars seem to shift or move against a distant background when they are seen from different positions. Astronomers are able to calculate the distance from a star to the Earth by knowing the distance of the two observation
points and their angles to the stars. Astronomers use trigonometry to calculate the parallax shift. If the parallax shift is small, we know that the star is far away from the Earth, and, conversely, if the parallax shift is large we know the star is close to Earth. The parallax shift method is only accurate for stars within a few hundred light-years away from Earth because when the stars are too far away, the shift is too small to measure. If you needed to measure the distance to stars more than 100 light years away, you could use Cepheid Variable Stars, a method that was discovered by an astronomer named Henrietta Leavitt in 1912. Cepheid Variable Stars are stars that change brightness periodically, and by comparing the apparent brightness of the star to the true brightness, you can calculate the distance. The true brightness is usually measured by how much power our sun gives out. Let’s say that a star gives out 1,000 times the power of our own sun. The true brightness would also be 1,000 suns.

Knowing how to estimate distances to far-away stars is important when scientists are trying to make contact with aliens or search for planets that could be inhabitable. They have to know how to measure everything from the width of the known universe to the amount of nitrogen in a sample of soil.

**SETI@home**

Just imagine your name being famous for finding extra-terrestrial life along with many scientists. You didn’t go to Mars, but you got some of the fame because volunteered your computer to be used in a project called SETI@home. SETI@home is a scientific experiment that uses Internet-connected computers to search for extra-terrestrial life. Thousands of computers are already involved in the global hunt for life beyond Earth, and more people can still volunteer their computers in the project. More people are joining the efforts everyday and helping scientists sift through the mountains of data being collected.

*Interstellar Radio Messages* (IRMs) are a large part of helping SETI make the huge
discovery about extra-terrestrial life. Back in 1995, David Gedye came up with the idea of sending IRMs by using a supercomputer. However, supercomputers are super expensive. So instead, SETI@home uses a network of Internet-connected computers. That’s why your computer is needed- so it can pick up and meticulously analyze the weak signals in a certain area of the sky. When your computer is sleeping, it will go to work detecting and monitoring radio signals.

The Arecibo Observatory in Puerto Rico.
Source: www.naic.edu/

IRMs are radio signals sent into space in the hopes of finding extra-terrestrial life. Obviously, sending these signals are a lot easier then traveling there. In 1974, the telescope Arecibo sent out the first IRM. It was a very simple message, and it was aimed toward a globular cluster of stars called M13. The message traveled 30,000 light years away! That means it will be quite a long time before we know for sure if anyone got our message. Scientists sent out more signals after a major discovery in 1995 of an exoplanet.

In 1995, an astronomer, Michael Mayor and one of his grad students, Didier Queloz, discovered an *exoplanet*, which is a planet orbiting another star. That discovery triggered many
scientists to want to send out IRMs to certain stars. Hundreds more exoplanets have been
discovered since then. Scientists send IRMs to stars with similar characteristics as our Sun and
with planets orbiting them. Some of the characteristics of these stars are they have to be 4 to
7 billion years old, the same or close in size as our Sun, constant luminosity, low eccentricity,
and, preferably, in our galaxy. Mainly that is the direction IRMs are sent, and we are left to see
if aliens will detect them somehow and respond. It is hard to know exactly when to send them,
though. Scientists think maybe IRMs should be sent during a universal event, like during a
supernova, even if it is in another galaxy. Today we have telescopes that can look deep into
space, so we can tell if a universal phenomenon, like a star exploding, is occurring.

IRMs are just one of the complex technologies used for the SETI project. It is unknown
if aliens exist. That is exactly why people are on the hunt searching deep into space. If you are
involved in SETI@home, you never know, but you could wake up one morning and realize your
computer was the one that detected extra-terrestrial life.

Conclusion

With all the technological tools at our disposal, it’s only a matter of time before we find
intelligent extra-terrestrials (if they’re out there). Through projects like SETI@home and
structures like the Arecibo Observatory, scientists and regular people are working together to
search the heavens and find any aliens that are trying to communicate with us. Computers have
drastically increased how far we can search and our understanding of what we should be
looking for. Curiosity, especially about the universe and our place in it, is an important part
about what makes us human. We will not stop looking until we find extra-terrestrial intelligence.
Eventually, through computer science, we will discover the truth.
Citations


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“SETI@Home: Search of Extra Intelligence at Home.” SETI@Home. Web. 19 Feb. 2012.


