Astronomy for Precise Positioning and Stellarium

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Abstract

Astronomy studies the Universe as a whole. Astronomyis the science that studies the origin and evolution of the Universe and everything in it. The present study discussed on the application of astronomy in general and explored its application on precise positioning specifically.Calendars, computers, communication satellites, navigation systems, mathematics, trigonometry, solar panels, wireless internet, culture and religions, and many other technological applications development such as aerospace, Global Navigation Satellite System (GNSS) or precise positioning, solar and nuclear energy, medicine, and many other technological applications development are all examples of astronomy. The study is conducted based on secondary information and astronomical observation using virtual application software. This paper also introduced the astronomical application software stellarium. The study shows that the astronomical knowledge and techniques are very useful for precise positioning.

Keywords: Astronomy, observational astronomy, precise positioning, GNSS, **stellarium**

Introduction

Astronomy is study of the sun, moon, stars, planets, comets, gas, galaxies, gas, dust and other non-Earthly bodies and phenomena. More generally, astronomy studies everything that originates outside Earth's atmosphere.It studies the Universe as a whole. NASA defines astronomy simply as "the study of stars, planets and space." Astronomy and astrology were historically associated, but astrology is not a science aerospace, and is no longer recognized as having anything to do with astronomy. According to Pudro,"Astronomyis the science that studies the origin and evolution of the Universe and everything in it. This definition seems simple, but the Universe is a vast place, filled with fascinating celestial objects of all sizes, shapes and ages, and with amazing phenomena." It is a science that studies celestial objects and phenomena in the Universe.

The universe isall of space and time and their contents, including planets, stars, galaxies, and all other forms of matter and energy. The Big Bang model tells the story of the evolution of the Universe around 14 billion years ago. There are 10,000 visible stars and 10^{11} to 10^{12} stars in our Galaxy, and there are perhaps something like 10^{11} or 10^{12} galaxies. The Age of earth is about 5 billion. Galaxy, and there are perhaps something like 10^{11}or 10^{12} galaxies. The Age of earth is about 5 billlion.

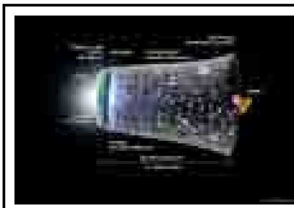

Fig 1 Universe

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There are two types of astronomy i.e. A.Observational Astronomy and B Theoretical Astronomy. Observational astronomy uses telescopes and cameras to *observe*or look at stars, galaxies and other astronomical objects. Theoretical astronomy uses mathematics and computer models to explain the observations and predict what might happen. Some observational astronomy are: 1.Radio Astronomy, 2.Infrared Astronomy, 3.Optical Astronomy, 4.Ultraviolet Astronomy, 5.Gamma-ray Astronomy, and 6. X-ray Astronomy.

The present study discussed on the application of astronomy in general and explored its application on precise positioning specifically. The study is conducted based on secondary information and astronomical observation using virtual application software.

The Applications of Astronomy

Astronomy benefits from and stimulates technology. It measures time or navigating the vast oceans. It also essential to many parts of our day-to-day life: computers, communication satellites, navigation systems, solar panels, wireless internet and many other technological applications development (Retre, 2019). It create awareness of celestial phenomena and its influence on their societies. For example, Calendar: humans recognized that the yearly cycle predictably repeats itself, they regulated agricultural, hunting, and religious activities by directly observing celestial phenomena; Navigation: the sky provided an alternative means to mark one's position during journey on desert and ocean; Mathematics: 360 degrees of the circle, annual circuit of the Sun around the sky in 365.25 days, spherical trigonometry; Cultural influences: The development of mythologies, astrologies, and religions also contain elements that help societies obtain a sense of order regarding the workings of celestial events.

Astronomy to the Aerospace sector

The aerospace sector shares most of its technology with astronomy — specifically in telescope and instrument hardware, imaging, and image-processing techniques. Some specific examples of astronomical developments used indefenseare given below (National Research Council, 2010): Observations of stars and models of stellar atmospheres are used to differentiate between rocket plumes and cosmic objects.The same method is now being studied for use in early warning systems. Observations of stellar distributions on the sky — which are used to point and calibrate telescopes — are also used in aerospace engineering.

Astronomers developed asolar-blind photon counter— a device which can measure the particles of light from a source, during the day, without being overwhelmed by the particles coming from the Sun. This is now used to detect ultraviolet (UV) photons coming from the exhaust of a missile, allowing for a virtually false-alarm-free UV missile warning system.The same technology can also be used to detect toxic gases. Global Navigation Satellite System (GNSS) rely on astronomical objects, such as quasars and distant galaxies, to determine accurate positions.

Astronomy in Global Navigation Satellite System (GNSS)

GNSS satellites send signals to a receiver in GNSS navigators down on Earth. These in turn calculate your position basedon the location of the satellites and your distance to them. Millions have come to rely on the precision of this system fora multitude of purposes, but to provide accurate position readings, theGPS system itself has to have a point of reference.

For GNSS to work, the orbital position, orephemeris ofthe satellites has to be known very precisely and in order to know where the satellites are, you have to know the orientation of the Earth very precisely. From our perspective on Earth, everything is always moving. For example, Earth wobbles as it rotates due to the gravitational pull from the moon and the sun, and even seemingly minor movements, such as shift in air and ocean currents and motions in the Earth's molten core, all influence the orientation of the planet.

It get a stable reference point, GNSS systems have to turnto the denizens of space. What are needed for the job are objects so remote that any motion they have is undetectable from Earth. They also need to be bright enough to be seen over the vast distance of space.

Quasars, which burn brighter than a billion suns, turn out tobe the perfect candidates. Quasars are thought to be powered by giant blackholes feeding on nearby gas. Gas trapped in the black hole'spowerful gravity is compressed and heated to millions of degrees, giving offintense light and/ or radio energy. Most quasars lurkin the outer reaches of the universe, over a billion light years away and soare distant enough to appear stationary from Earth's perspective.

A collection of remote quasars, whose positions in the sky are precisely known, forms a map of celestial landmarks in which to orientthe Earth.The first such map, called the International Celestial Reference Frame (ICRF), was completed in 1995. By Space.com Staff November 03, 2009

Quasars

Anextremely luminous active galactic nucleus (AGN), in which a super-massive black hole with mass ranging from millions to billions of times the mass of the Sun is surrounded by a gaseous accretion disk. As gas in the disk falls towards the black hole, energy is released in the form of electromagnetic radiation, which can be observed across the electromagnetic spectrum.

Figure 2 Quasars

Astronomy to the energy sector Crude Oil Refinement

Several companies uses IDL, or Interactive Data Language (create meaningful visualizations out of complex numerical data), to analyze core samples collected from functional oil fields.

Nuclear Energy: X-ray telescopes, which can now monitor and analyze plasma fusion, have the potential to create nuclear energy that is even cleaner and safer than its current state.

Solar Energy: solar radiation collectors

Figure 3 Resources and Energy

Astronomy and Medicine:

Astronomers struggle constantly to see objects that are ever dimmer and further away. Medicine struggles with similar issues: to see things that are obscured within the human body. Small thermal sensors initially developed to control telescope instrument temperatures are now used to control heating in neonatology units — units for the care of newborn babies.

Application in precise position

Kepler, 1571 used astronomy for precise positioning. Cassini, 1672 used a technique called parallax to measure the distance to Mars. In celestial navigation, the Sun is most commonly used, but navigators can also use the Moon, a planet, Polaris,or one of 57 other navigational stars.

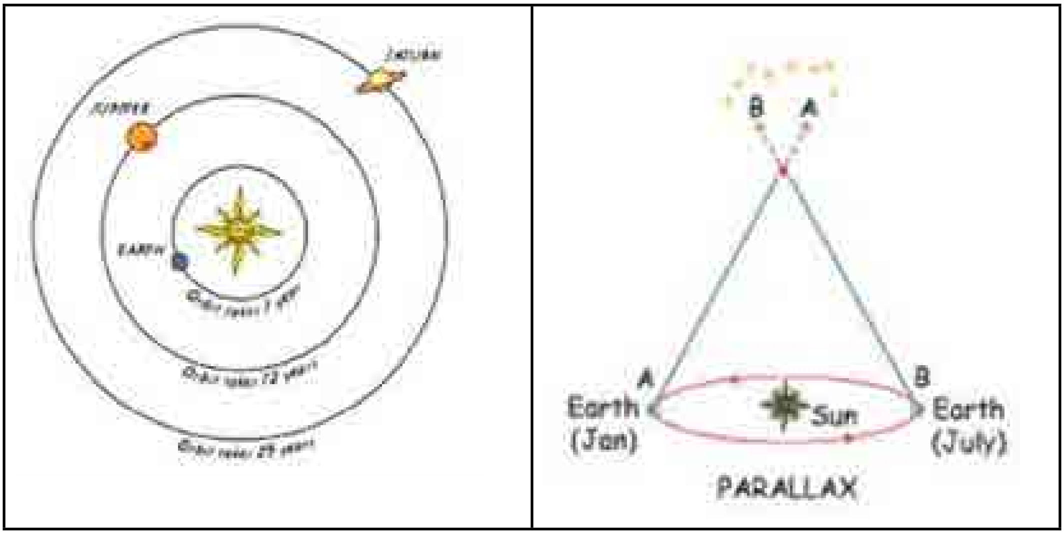


Figure 4 Precise positioning based on astronomy

Google Sky Map and Stellarium are some common online application software for precise positioning of universe. Retre, 2019 used Augmented Reality Technology based on Motion Sensing and Automatic Positioning Universal Planisphere. Doppler navigation (Ames, 2019) and satellite signal are useful for precise positioning.

Sun based positioning (Zhang,XiaofengandYuanzhe2015)

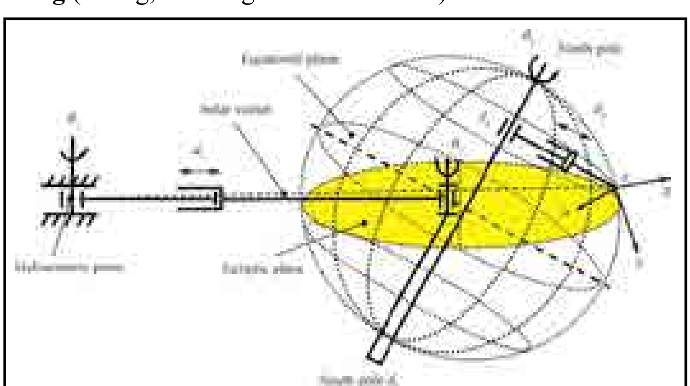


Figure 5 Sun based positioning

Regular Observation of Celestial Body

Stellar Astronomy

The field of stellar astrophysics is the study of the origin, formation, evolution, and fate of stars and of the mechanisms (either nuclear, atmospheric, or exterior interactions with companions/other objects) by which they work and interact with their stellar environment.The study of stars and stellar evolution i.e. the process by which a star changes over the course of time, the focus of stellar astronomy is on the physical and chemical processes that occur in the universe.

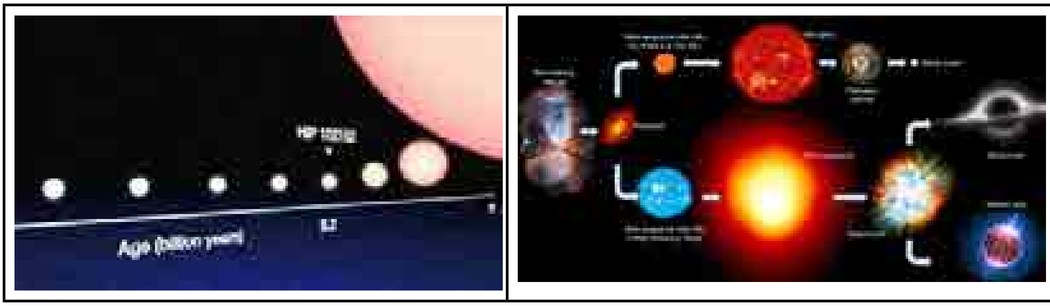


Figure 6 Stellar Astronomy

Study of Stellarium

Astrometry, the measurement of stellar positions, yields parallaxes, propermotions, and apparent orbital motions.

Photometry, the measurement of the quantity of light received atall apparent brightness's (apparent magnitudes), colors, and variability of stellar brightness's.

Spectroscopy, the dispersion of light into its component colors to determine the stellar energy distribution as a function of wavelength, produces spectral types, luminosity classes, strengths of absorption and emission features from which chemical composition may be deduced, and Doppler shifts.

RADIO TELESCOPES: Radio telescopes look toward the heavens to view planets, comets, giant clouds of gas and dust, stars, and galaxies. By studying the radio waves originating from these sources, astronomers can learn about their composition, structure, and motion. Radio astronomy has the advantage that sunlight, clouds, and rain do not affect observations. physical properties of stars, usually based only on a little bit of light

DISTANCE. This is determined from trigonometric and spectroscopic parallaxes.

Determining distances is*CRUCIAL* to understanding stars because we can use distances to figure out ◦the scale of things in the Galaxy and◦how much energy stars produce and radiate away - by using the inverse square law for light dimming along with apparentbrightness's.

LUMINOSITY. This is the amount of energy generated in the star and released as electromagnetic radiation.

BRIGHTNESS. This is not a fundamental property but a combination of the luminosity and distance to a star (and in some cases it is also dependent on the amount of absorption in the direction of a star).

RADIUS."Size" of the star - calculated from Stephan's Law.

CHEMICALCOMPOSITION. This is determined from absorption line spectra; it is tied up in a semi-complicated way with temperature.

TEMPERATURE. We have talked about Wien's Law and using colors to derive stellar temperatures, but there are some complications. To *REALLY* get to surface temperatures of stars, we need to learn about and understand stellar *spectral types*.

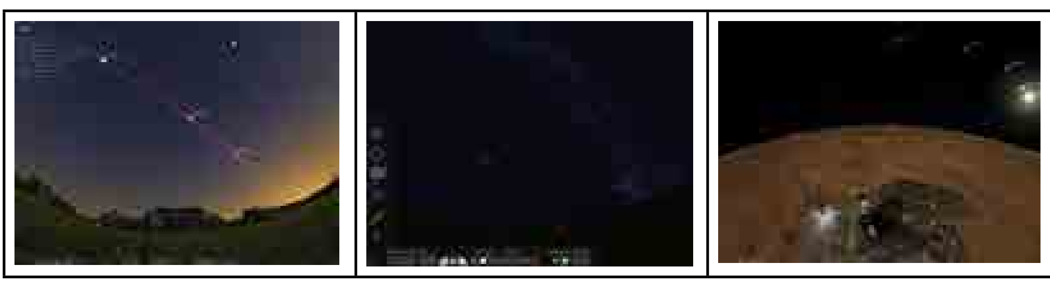
Stellarium–Software Demonstration

- Open Source Software, that allows people to use their home computer as a virtual planetarium.
- Calculates the positions of the sun and moon, planets and stars, and draws how the sky would look to an observer depending on their location and the time.
- Not too bad substitute for stargazing.
- https://stellarium.org/

Features

- Realistic simulation of the sky; sunrise and sunset
- Default catalogue of over 600,000 stars
- Downloadable additional catalogues for up to 210 million stars
- Catalog data for all New General Catalogue (NGC) objects
- Images of almost all Messier objects and the Milky Way
- Artistic illustrations for all 88 modern constellations
- More than a dozen different cultures with their constellations
- Solar and lunar eclipse simulation
- Photorealistic landscapes (more are available on the website)
- Scripting support with ECMAScript (a few demo scripts are included)
- Extendable with plug-ins: 21 plug-ins installed by default, including:
- artificial satellites plug-in (updated from an on-line TLE database)
- ocular simulation plug-in (shows how objects look like in a given ocular)
- Solar System editor plug-in (imports comet and asteroid data from the MPC)
- telescope control plug-in (Meade LX200 and Celestron NexStar compatible)
- Remote control via web interface plug-in
- 3D landscapes plug-in

Images from Stellarium



Conclusion

Astronomy is the study of the entire Universe. It focused on the Universe's origins and evolution, as well as everything in it. The current research looks into the use of astronomy in general, as well as its application to precise positioning in particular. The research is based on secondary data and astronomical observations, and it is carried out using virtual application software. Astronomy is applied on many parts of our day-to-day life: calendar, computers, communication satellites, navigation systems, mathematics, trigonometry, solar panels, wireless internet, culture and religions and many other technological applications development such as aerospace, Global Navigation Satellite System (GNSS) or precise positioning, solar and nuclear energy, medicine etc. The astronomical application software stellarium was also introduced in this paper. The research demonstrates that astronomical knowledge and techniques are extremely beneficial for precise positioning.

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