Global Positioning System

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It is the only system that enables an individual to find his exact position on the Earth anytime, in any weather, anywhere. GPS satellites, orbit at 11,000 nautical miles above the Earth. They are continuously monitored by ground stations located worldwide. The satellites transmit signals that can be detected by anyone with a GPS receiver. And it's by means of the receiver, that the location an individual with great precision can be determined on earth. Since prehistoric times, people have been trying to figure out a reliable way to tell where they are, to help guide them to where they are going, and to get them back home again. It's virtually in analogy with the system that the birds, flying across the continents possess.

In the early 20th century several radio-based navigation systems were developed, which were used widely during World War II. Later, the scientists decided that the only way to provide coverage for the entire world was to place high-frequency radio transmitters in space. A transmitter high above the Earth sending a high-frequency radio wave with a special coded signal can cover a large area and still overcome much of the errors encountered on the way to the ground. This is one of the main principles behind the GPS system.

Elements of GPS

GPS has 3 basic elements:
- the space segment
- the user segment
- the control segment

The space segment consists of 24 satellites in total, each in its own orbit 11,000 nautical miles above the Earth. The user segment consists of receivers, which can be installed in a ship, plane and can be even held in hand or mounted in a car. The control segment consists of ground stations (five of them, located around the world) that make sure the satellites are working properly.

The GPS satellites each take 12 hours to orbit the Earth, and each of them is equipped with an accurate clock to let it broadcast signals coupled with a precise time message. The ground unit receives the satellite signal, which travels at the speed of light. But, don't take is as a instantaneous process; even at this speed, the signal takes a measurable amount of time to reach the receiver. The GPS system can tell you your location anywhere on or above the Earth. However, there may be an approximation of 300 feet. But, greater accuracy — usually within less than three feet — can be obtained with corrections calculated by a GPS receiver at a known fixed location. The satellites also tell us exactly where they are in their orbits above the Earth. Each satellite generates radio signals that allow a receiver to estimate the satellite location and distance between the satellite and the receiver. The receiver uses the measurements to calculate where on or above the Earth the user is located.

Uses in Everyday Life

New ways to use this system's capabilities are continually being found. For example, during construction of the tunnel under the English Channel, British and French crews started digging from opposite ends: one from Dover, England, and the other from Calais, France. They relied totally on Global Positioning System receivers outside the tunnel to check their positions along the way and to make sure that they meet exactly in the middle, proving the successful application of GPS.

Vehicle tracking is another of the fastest-growing GPS applications. Equipped fleet vehicles, public transportation systems, delivery trucks, and courier services use receivers to monitor their locations at all times.

Many police, fire, and emergency medical service units are using GPS receivers to determine the police car, fire truck, or ambulance nearest to an emergency, enabling the quickest possible response.

Automobile manufacturers are offering moving-map displays guided by GPS receivers as an option on new vehicles. The biologists also started to use a handheld GPS receiver in wildlife research projects. If you have access to National Geographic TV channel, you can watch this particular application of GPS yourself. Archaeologists and explorers are using the same system.

Anyone equipped with a GPS receiver can use it as a reference point to find another location. Further to amaze the mankind, the future of GPS is as unlimited as the imaginations. New applications will continue to be created as the technology evolves.

New Milky Way views: active centre, gas-strewn e

By Peter N. Spotts

Science & Technology Da

WASHINGTON: Armed with new telescopes, high-speed computers, and data from ambitious all-sky surveys, researchers are gleaning new insights into the structure and inner workings of the Milky Way.

Discoveries announced this week range from the center of our home galaxy to its furthest reaches.

In the process, the galaxy is increasingly coming to be viewed as an astronomical ecosystem.

"What we really want to understand is how ... different components of the galaxy interact," says Daniel Wang, an X-ray astronomer at the University of Massachusetts at Amherst. That understanding will, in turn, pay dividends as researchers try to plumb the secrets of the more-distant galaxies that populate the cosmos.

"Our galaxy really is a laboratory," says Vera Rubin, an astronomer at the Carnegie Institution of Washington.

The Milky Way has been sketched in increasing detail in the decades since Harlow Shapley first located its center in 1918 and gave the world the notion that it consisted of a central bulge surrounded by a disk. But surprises continue.

For example, astronomers knew of a halo of gas extending up to 33,000 light years from the galaxy and thought to be driven by stellar explosions in the disk.

A team of researchers recently announced its discovery of a more-extended, tenuous envelope of hot gas wrapping the galaxy, with a mass 10 million times greater than the sun's. This galactic corona extends at least 150,000 light years from the center of the Milky Way, according to the research team, led by Kenneth Stembach, an astronomer with the Space Telescope Science Institute in Baltimore, Md. The announcement came at the American Astronomical Society winter meeting here.

The team discovered the corona as it studied cold clouds of intergalactic gas that pelt the galaxy at high velocities. The researchers noted that the clouds' surfaces grew extremely hot as they approached. They concluded that the dense clouds were passing through a shroud of gas and being heated much like meteors when they plunge into Earth's atmosphere.

This discovery could help researchers pin down the mechanisms that gave rise to the galaxy. Dr Stembach notes that this corona could represent a galactic "wind," the echo of an enormous burst of star formation earlier in the galaxy's history. Or it could represent fossil evidence of heating that took place as gas fell in toward a fledgling Milky Way and heated as it met more gas and was compressed by gravity.

"Any model for the formation of galaxies like our own will now have to include such information," he says.

Other discoveries are coming as the galaxy is viewed through fresh telescopic eyes. This week, a team led by Dr. Wang unveiled a mosaic image of the Milky Way's nucleus. The image, of a 400-by-900 light year patch of the galaxy, was taken with NASA's Chandra X-Ray Observatory.

Astronomers have long seen the center of the galaxy as a copious source of X-rays, but their origin was a mystery. Some researchers had proposed that the emissions came from a huge reservoir of gas at a searing 100 million degrees Celsius. But if the gas were so hot, why didn't it expand and dissipate?

Optical observations didn't help, because the center is obscured by interstellar dust. Chandra, showing objects in finer detail than other x-ray instruments, allowed astronomers to distinguish between individual sources, such as neutron stars and black holes, and more diffuse sources,

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such as hot-gas clouds. Chandra, revealed that individual sources account for much of the x-ray emissions.

A team led by Michael Skrutskie at the University of Virginia in Charlottesville has used data from the 2MASS infrared all-sky survey to develop the first "bird's eye" view of the galaxy. Taking the images in the infrared portion of the electromagnetic spectrum allows astronomers to see through intervening dust. Guided by "standard candles" — 30,000 stars known to have a common brightness — Dr Skrutskie's galactic map is the first to be generated by directly measuring the distance to stars all over the galaxy.—*Dawn/The Christian Science Monitor News Service.*