Space Sciences

Saturn's 18th moon linked to dusty object

Last year, Mark R. Showalter completed a painstaking computer search through some 30,000 images of Saturn, each obtained more than a decade ago by Voyager 2. His labor resulted in the discovery of Saturn's 18th moon, now known as 1981 S13 – the only satellite known to lie within the planet's main system of three clearly visible rings (SN: 8/4/90, p.69). Further analysis of the photos has now enabled the astronomer to pinpoint the position of this satellite – soon to be renamed Pan – to within 1 kilometer.

The finding, says Showalter, an astronomer at Stanford University, makes Pan "the most accurately determined location of anything in Saturn's ring system." As a result, astronomers can now use Pan as "an anchor," or reference point, for locating other ring features with five to 10 times the previously existing accuracy. Showalter reports the findings in the June 27 NATURE.

Tracking Pan through photos taken during nine of its consecutive orbits, Showalter calculated that the moon lies 133,583 km from Saturn's center. Pinpointing that distance makes it possible to more accurately measure, for example, the position of spiral density waves – local distortions in the main rings that orbit in sync with Saturn's moons outside the rings. He also found that Pan's orbit – at the center of a 320-km-wide region called Encke's gap, inside Saturn's outermost main ring – coincides with that of a dusty ringlet. Showalter says the matching orbits indicate that the ringlet formed when micrometeoroids bombarded Pan, chipping off small bits of it.

Showalter says he has "bled dry" Pan studies with the Voyager images. But the possibility of pinpointing Pan with even better accuracy may lie just a few years away. Showalter holds out hope that the Hubble Space Telescope may glimpse the satellite during a rare alignment of Earth and Saturn in 1995.

In that year, Earth's orbit will permit a brief, edge-on view of Saturn's rings. Hubble, which by then should have received corrective optics to compensate for its flawed primary mirror, may be able to discern Pan (with a radius of about 10 km) sticking above or below the plane of the rings like a bug on a phonograph record, Showalter says. If that observation doesn't pan out, researchers will have to await high-resolution photos sent back from the planned spacecraft Cassini, scheduled to reach Saturn early next decade.

Panel supports Earth-observing satellites

Earlier this month, the National Research Council gave its approval to a planned 20-year, $30 billion program of polar-orbiting spacecraft called the Earth Orbiting System (EOS). These NASA satellites would monitor physical conditions in the atmosphere, in oceans and on land, and assess marine and terrestrial ecologies. EOS, scheduled to begin in 1998 as part of a larger remote-sensing project known as Mission to Planet Earth, constitutes "the largest single component of the most ambitious scientific enterprise ever undertaken," the report observes. But NRC, the research arm of the National Academy of Sciences, adds that conclusions in its new report should "simultaneously inspire confidence and generate concern."

EOS appears to lack the flexibility to incorporate new technologies and to adapt to new requirements during its operational life, the report says. Moreover, the data system intended to disseminate information from EOS spacecraft is not yet fully developed, the document notes. Once that system does begin transmitting EOS data, NASA should ensure that other federal agencies and research groups obtain easy access to the new and vital knowledge, NRC says. Finally, the authors of the report remind NASA to prepare back-up contingencies in case any of the instruments fail, and to develop ground-based programs to complement observations from space.

Technology

Software may ensure safer landings

Hydraulic failure: The words provoke anxiety in the bravest of jet pilots. In these rare accidents, pilots have almost no control of their aircraft and a disastrous crash landing becomes nearly unavoidable.

New computer programs may one day prevent such catastrophes in multi-engine jets, NASA engineers reported last month at a meeting of the American Institute of Aeronautics and Astronautics in Sacramento, Calif. Instead of manipulating the aircraft's rudder, ailerons, and elevators to land as they normally do, pilots with disabled hydraulic controls would rely on engines to land safely. Activated after hydraulic failure, computer software would translate the pilot's control-stick movements into engine throttle commands. Thrusting the engines at different speeds would allow a plane to turn, climb, descend and land, explain the system's developers at NASA's Ames-Dryden Flight Research Facility in Edwards, Calif.

Several recent crashes involving hydraulic failure – particularly a 1989 accident in Iowa – motivated NASA to develop the software. Though pilots of the United Airlines plane managed to steer their mammoth DC-10 to the Sioux City runway by manually controlling its engines, they were unable to land safely. The resulting crash left 111 passengers dead.

The new software system has been tested on various flight simulators, including ones for the McDonnell Douglas F-15 and Boeing 720. These simulations showed that with only manual control of the engines, crews could maneuver their planes but would have great difficulty landing. With software-controlled engines, however, pilots repeatedly simulated safe landings – even in turbulence and crosswinds.

Sound sensing

Acoustic wave detectors – sensitive scientific instruments about the size of a microscope slide – rely on ultrasonic waves to detect a variety of materials. The recent development by Maine researchers of a prototype to measure hydrogen-sulfide levels has sparked interest in the new devices. The team is now working to detect fragments of DNA and viruses.

These relatively simple sensors work quickly and could cost little, note John F. Vetelino and his colleagues at the University of Maine, Orono. Most acoustic wave detectors consist of a millimeter-thick substrate – often a crystal such as lithium niobate – with tiny electrodes attached that emit acoustic waves at frequencies beyond the range detectable by human ears.

Normally, wave characteristics such as frequency, amplitude and velocity would remain constant as the electrode-generated sound waves traveled from one end of the substrate to another. But Vetelino's team coats the crystal's surface with a material that will interact with whatever their sensor is designed to detect. This interaction alters the acoustic waves passing through the substrate, and monitors attached to the crystal note those acoustic wave changes.

For example, the Maine researchers coated the substrate of an earlier detector with a thin layer of tungsten trioxide. Because this coating chemically binds hydrogen sulfide, sound waves passing through the device differ in a characteristic way when the poisonous gas is present. Such a detector may one day monitor air in paper mills, which can emit the toxic gas.

Vetelino's group is now developing similar detectors whose substrates are coated with biological materials. In one, a coating of antibodies helped the researchers detect immunoglobulin G. Another sensor being tested by the Maine team searches DNA for specific genetic sequences. Vetelino, an electrical engineer, is also working with IBM to design acoustic wave detectors that can probe adhesive coatings between computer chips to determine why they sometimes fail.