Space

Tips for spacecraft builders

A rocket nozzle that unfolds in space and a solar cell that lets in more light may benefit spacecraft of the future.

The nozzle, developed by Bell Aerospace, Buffalo, N.Y., for U.S. Navy missle research, is equipped with hydraulic arms that pull back the nozzle's outer rim like folding back the rim of a conical paper cup. This can substantially reduce the overall length of the nozzle, which could, for example, allow longer payloads to be carried by the space shuttle. Made of "shear-spun" tantalum or columbium, the nozzle can be used even with high-temperature propellants.

For power-thirsty spacecraft, researchers at COMSAT Corp. have developed a silicon solar cell that is up to 50 percent more efficient than those now in use, thanks to a process which shapes the cell's front surface into tens of thousands of microscopic pyramids. This essentially makes the surface less shiny, so that less sunlight is lost by reflection. The pyramids also angle the incoming light so that more of it stays near the cell's power-producing junction region, for an overall conversion efficiency of about 15 percent.

Semi-autonomy sought for robots

A roving robot capable of finding its own way and even doing its own simple research is being developed for future missions to distant planets.

Controllers on earth were adequate for guiding a rover such as the Soviet Lunik, which wandered the moon, but this would be impractical in the outer part of the solar system, where control signals from earth and feedback from the robot could take more than an hour. It would be like driving a car with wheels that turned an hour after the steering wheel. The solution being tried by researchers at the Jet Propulsion Laboratory and California Institute of Technology is to develop a robot that can make its own choices without constant guidance.

So far only a group of components spread out on a table in a converted helicopter hangar at JPL, the robot is envisioned as ultimately being able to recognize boulders, cliffs and craters and to avoid them in its travels. Instructed to pick up a rock, it will be able to estimate the rock's weight and density and relay the data to earth without human intervention. Equipped at present with a laser rangefinder, TV cameras and a manipulating arm, the robot should be ready by January to pick up a rock, show it to the cameras and put it on the table. In July, the researchers hope to mobilize the device by mounting it on a VW-sized flatbed vehicle.

Computer techniques and component miniaturization are among the problems of the research team, headed at JPL by William M. Whitney, since both are stretching the state of the art. The robot's operational successors are not likely to be ready for work, such as a trip to Mars, until 1985 or 1986.

Space pioneer Debus to retire

One of the country's foremost space pioneers, Kurt H. Debus, is preparing to retire from the National Aeronautics and Space Administration. Director of Kennedy Space Center since its establishment in 1962, his 30-year career in the Army and NASA has included supervising the launch of the first Redstone ballistic missile in 1953 and the first successful U.S. earth satellite, Explorer 1, in 1958. He has directed activities at KSC throughout the entire Mercury, Gemini, Apollo and Skylab programs.

Behavior

Thinking warm

Ever try "thinking warm" to unfreeze cold fingers? Don't knock it. Psychologist Edward Taub has taught experimental subjects to change the skin temperature of their hands by as much as 15 degrees F. using thermal imagery and biofeedback. Nineteen out of 20 subjects in a study at the Institute for Behavioral Research in Silver Spring, Md., learned some thermal autoregulation after only about an hour of practice. Those whose skin temperature showed a tendency to drop in a baseline test were trained to raise it. Those who naturally heat up learned to cool off. Some were also taught to reverse directions. Sitting alone in an insulated booth with thermistors taped to their hands, subjects were encouraged to use their imagination in dreaming up hot or cold images—whatever produced the effect that was desired.

A lighted display gave them immediate readings of temperature changes to let them know how well they were doing. Physiologically, the volume of blood flowing in their hands—which determines temperature—was brought under control by changing the diameter of the local arteries and capillaries.

Taub says retention of the skill is good for at least four or five months and that with proper training subjects have been able to maintain control even without feedback. He thinks the technique may prove useful in reducing frost nip and enhancing manual dexterity in very cold environments. In preliminary tests it has also shown potential as a therapy for persons suffering from Raynaud's disease, a vascular disorder characterized by painfully cold fingers.

But there seems to be one catch. Taub calls it the "person effect." Learning thermal autoregulation is so dependent on the autonomic nervous system that it is highly susceptible to being "swamped" by an unfavorable emotional climate. When an "impersonal nonbeliever" conducted the training, only 2 of 22 subjects were successful.

Why counting sheep works

"The age-proven procedure of visualizing *and* counting sheep to fall asleep when one's mind is racing succeeds because it effectively blocks both unwanted visual and auditory imagery at the same time," suggest Harvard psychologists Richard Davidson and Gary Schwartz. According to their psychophysiological theory of relaxation, the best way to get rid of any particular pattern of anxiety is to displace it with other behavior of the same type. Visualizing sheep prevents the brain's right hemisphere from processing anxiety-provoking picture imagery (unless one happens to fear sheep). Counting them keeps the brain's left hemisphere from straying into problematic auditory or verbal thoughts.

Similarly, if you're physically tense, jogging or a meditation technique such as Hatha Yoga, which employs physical exertion, might be the best way to relax. A high degree of mental stress would call for reading, chess or hypnotic suggestion. Lower levels of mental and verbal anxiety might be allayed by a technique like transcendental meditation, which involves merely repeating a mantra. "A new direciton in therapy may be to teach people to recognize in themselves when they are experiencing what kinds of anxiety, and how to best eliminate it," suggest the theorists in a forthcoming book, *Behavior Control and Modification of Physiological Activity*, to be published by Prentice Hall.