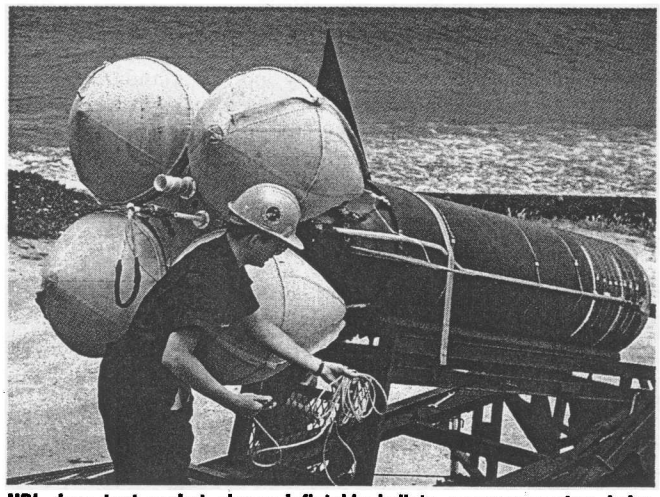
which do not touch but still pass a tunneling current between them. That current is extremely sensitive.

"These sensors have about 10,000 times the sensitivity compared with current piezoelectric devices," Nicastri said.

The tunnel technology could revolutionize infrared and other sensor technologies. Systems using the technique could be sensitive enough to measure gravity waves, Nicastri believes.

■ High-throughput computer. DARPA is developing a high-throughput space-based super computer/parallel processor that would be only 5 in. square and capable of 40 billion operations per second. This is several times more capability than available today in larger systems and is one of several DARPA computer efforts to increase spacecraft on-board computing capability. DARPA is doing this work with Space Computer Corp. of Santa Monica, Calif., Nicastri said.

Another major computer project is the Air Force Advanced Spaceborne Computer Module (ASCM) program to develop critical building blocks for advanced on-board satellite processing capability. The program seeks to build a manufacturing base for radiation-hardened, generic very-high-speed integrated circuit chip sets and specific ASCM program computer hardware.



NRL drop test rocket shows inflatable ballute recovery system being tested as a Navy SEALAW Sea Launch and Recovery System option.

■ Communications technologies. Various DARPA efforts in UHF and communication bands are examining new modulation schemes with frequency reuse and antijam capability. These systems would use lighter-weight spacecraft transponders and handheld receivers to enable more direct battlefield communications through small satellites.

DARPA is also working with the Jet Propulsion Laboratory on super high frequency areas related to Defense Satellite Communications System DSCS-3 type operations to reduce the size and weight of DSCS user equipment.

DARPA also is looking at highly advanced technologies in extremely high frequency (EHF) applications in connection with Massachusetts Institute of Technology's Lincoln Laboratory and multiple contractors, such as Electromagnetic Sciences Corp.

Lincoln built an experimental EHF package that flew on a FleetSatCom spacecraft as a precursor to Milstar EHF satellite operations. That package weighed about 225 lb.; the goal of the effort is to get the weight of the system down to 55 lb. or lower to enable major EHF systems to possibly fly on a smaller version of Milstar.

Defense Dept. interest in smaller, more autonomous spacecraft that can be used by troops in the field was demonstrated by DARPA/Naval Space Command use of one of two 150-lb. MACSAT multiple access communications satellites launched on a Scout booster in 1990.

The store/dump UHF communications satellites were in a Phase 1 demonstration period when Naval Space Command requested their use operationally to support logistics communications between the 2nd Marine Air Wing in Saudi Arabia and its home base at Cherry Point, N. C.

Naval Space Command officers believe the use of MACSATs in Desert Storm was a classic example of the type of flexible satellite support that will become available to Navy and Marine units on a broader scale. Army and Air Force commanders echo this hope.

The Navy especially is interested in improved ocean surveillance sensors and automatic target recognition capabilities. Another challenge in space systems is to fuze the data from multiple sources into a coherent picture.

Better environmental data keyed to naval operations represent another critical area, according to William Howard, who heads technology at Naval Space Command. Launch of a new spacecraft with a radar altimeter to replace the Geosat spacecraft that expired in January, 1990, is a priority. Naval Space Command supplies its space system requirements, many of which involve classified sensor developments, to the Naval Research Laboratory (NRL).

One of NRL's largest space projects is its SEALAW (Sea Launch and Recovery) program to develop a water-launched recoverable space booster. NRL has been working on the program for three years with a total of $14 million in funding, according to Peter G. Wilhelm, director of NRL's Naval Center for Space Technology.

The objective is to prove the concept of a low-cost, water-launched recoverable system that could place up to 20,000 lb. into low orbit at a cost of only about $1,000/lb. with a minimal launch facility infrastructure. Once the concept is proven, NRL would turn it over to a commercial developer.

NAVY BARGE

NRL has been given an aged Navy barge used originally to support a submarine tender in Scotland. The barge has been outfitted as a control center and logistics base, with a rocket engine test stand on its stern and a side-mounted rig to static fire the small rocket engine planned for use in NRL's X-3A test vehicle.

The X-3A is a 25-ft. oxygen/kerosene powered vehicle that NRL plans to launch from the water and recover by about July. Launch will be off San Clemente Island, Calif., with a parachute recovery.

NRL and DARPA are working on a parasail for the recovery technique that would be used later on a more operational vehicle. Both the first and second stages of the SEALAW vehicle would be recovered.

After demonstrating X-3A launch and recovery, NRL would develop a 52-ft. Sea Horse rocket powered by a modified pressure-fed Rocketdyne engine built originally for the Thor booster.

If the program proceeds as planned, NRL would first launch at least one suborbital Sea Horse test followed by an orbital mission attempt by about 1995. The vehicle's second stage would use a liquid oxygen/hydrogen engine, which is being developed by Truax Engineering.

A more traditional NRL research program into high-temperature superconductivity eventually could provide major capability increases to both military and civilian spacecraft.

NRL's high-temperature superconductivity space experiment (HTSSE) is set to be carried as a secondary payload on a larger satellite to be launched next year on a Titan 4, according to George E. Price, a project manager.

The HTSSE will demonstrate the feasibility of high-temperature (77K) superconducting systems in space by using a 200-lb. cryogenic nitrogen-cooled system to test the performance of multiple devices in a space-based system. The experiment has been structured to leverage the U. S. national program in high-temperature superconductivity and focus a major portion of the effort into space applications. □