have many applications and have been acquired by a number of agencies. The data are basic to maps in earth sciences where distributions of economic value or population density are presented against a geographic background. They are useful in the preparation of updating of highway and weather maps. In a significant military application, the data are used by defense commands to display the position and motion of potential targets in relation to coast lines. Such displays constitute an important part of any decision to take countermeasures. In one interesting application the data are used at the Houston Space Craft Control Center to show astronauts just how the coast lines on the earth will appear to them when they are in orbit. Soon there will be a need for maps to show how the crators of the moon will appear to astronauts!

The data have applications in the Navy in connection with the optimization of the allocation and scheduling of shipping. Currently under consideration is an application to maps which show the paths of the shadows of eclipses of the sun. Another application is in the development of new methods for mapping the earth.

Effects of water on bearing fatigue

The presence of water in hydraulic fluids and in lubricating oils has a deleterious effect on naval machinery. Interaction of the water with stressed metal surfaces accelerates failure of bearings and gears. The presence of 0.01 percent dissolved water in the lubricant has caused reductions of 27 to 78 percent in surface fatigue life depending on the applied stress. Independent Research at the Annapolis Division of the Naval Ships R&D Center has led to a possible mechanism for this remarkable phenomenon. It is as follows: Microcracks in the surface of the ball act as capillaries. Water in the lubricant at a concentration that permits capillary condensation forms a water-rich phase in the cracks. Aqueous corrosion in the cracks and dynamic stress on the surface then combine to cause the reduced fatigue life. With this understanding of the phenomenon, research has been initiated to find means to minimize such effects.

Delivery of airborne weapons

In the past the designer of weapons to be launched from aircraft assumed a specific dive angle, speed, etc. Wind-tunnel tests were made for the assumed conditions to verify the design. However, these tests were not extended to determine the limits at which a given weapon could no longer be safely launched by a given aircraft. Both in experimental flight tests and in combat missions under conditions different from those assumed by the weapon designer, improper separation of weapon and aircraft caused damage to or loss of the aircraft or failure in delivery of the weapon. The Navy laboratories were called upon to correct each case as it occurred. At the same time, however, they recognized the necessity for better design data and for an ability to predict the limits of safe delivery for various combinations of aircraft and weapons. To enhance prediction capability, all experimental data available have been collected in a data bank, and computer orograms have been developed for the launch of conventional weapons. In addition to the problems of separation, the current methods of shaping, carrying, and delivering weapons increase the drag of the system significantly and reduce aircraft performance. Accordingly, the feasibility of using unconventional shapes which can be carried on the aircraft in a low-drag configuration was explored at the Naval Ships R&D Center (Carderock). Analytical studies and wind-tunnel tests at subsonic, transonic, and supersonic speeds confirmed that weapons which are rectangular solids can be carried at a drag level which is a small fraction of that of present weapons. Static and dynamic wind tunnel tests also established the technical feasibility of aerodynamic stabilization of rectangular solid shapes. With these demonstrations of feasibility and of the potential of these studies to solve many of the problems of stores separation, these developments have been transferred from IED funding to support by the Naval Air Systems Command.

AIR FORCE EXAMPLES

Laser night photo reconnaissance

The potential applications of the laser technology are many and varied. The Laboratory Director's Fund permitted the Air Force Avionics Laboratory to finance an in-house effort in 1963 to explore the use of lasers as an illuminant for night photography. The narrow beam capability of coherent light can achieve 10 times more illumination per unit area than any other source with the same input power. Moreover it could be essentially a covert means of reconnaissance.