



FINAL REPORT

PREPARATION OF DYNAMIC GRAVITY TESTING SYSTEM

ONR CONTRACT NO. N00014-89-K-0023

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BACKGROUND

Bowin's interest at WHOI is to obtain the most accurate gravity and gravity gradient measurements possible. The Navy's interest is to have the most accurate navigation possible. Neither can have one without the other. Through Zarak Corporation, Bowin has proposed to the Navy Air System Command to develop a dynamic navigation/gravity/gravity gradient (NAV/GRAV) system utilizing superconducting squid gravity and tensor gravity gradient sensors for high precision performance. The proposed system development incorporates that inter-dependency, not only to provide the best estimates of both, but also to provide estimates of the quality of the results obtained. Zarak is pursuing funds for the development of superconducting gravity and gravity gradient sensors. Such sensors, when available, will then be utilized in this palletized system for higher accuracy navigation, gravity and gravity gradient determination. It is desired that initial testing utilize Vibrating String Accelerometers (VSA) gravity sensors and readout systems available at WHOI. This way the development and testing of the NAV/GRAV system can proceed using the VSA sensors while the superconducting gravity sensors are being fabricated. Initial dynamic systems tests will be in a van vehicle for convenience and practicality. The system units will be palletized, and therefore they shall be easily transferable, and thus also be usable in aircraft and ships. It is planned that WHOI will have loan of prototype systems for about two months each year for earth research use.

PRESENT STATUS

Two (2) aircraft ASN-140 Honeywell Ring Laser Gyro Inertial Navigation Systems were received from the Navy Air Test Center. One INS system is functional, the other is for spare parts back-up. Following a presentation by Bowin at the Pentagon in July 1988 we received at WHOI \$50,000 from ONR with a 1 October 1988 start date for preparation of a van vehicle test platform utilizing WHOI's Vibrating String Accelerometer (VSA) gyrostabilized and strap-down gravity sensors. The VSA gravity sensors are stand-in sensors to allow INS-gravity-computer-speed-sensor-altitude sensor system integration and testing to commence. In the three months, October, November, and December, 1988, Bowin had the free assistance of an extremely capable and competent senior engineer from the shipbuilding ministry of the People's Republic of China. In those few months this engineer, with the help of WHOI shop personnel, assembled nearly all the hardware components of the Van System. The radar speed sensor and the precision microbarometer (both with digital output) arrived after the PRC engineer returned to China at the end of the year. A CDI (Control Display Indicator) circuit board for control of the ASN-140 INS for installation in one of the system's two IBM PC clones was received in time, but lack of an Export License prevented me from being able to show the manual for the ASN-140 INS to the PRC engineer. Hence, we lost his help in integrating the INS into the Van System. We also came to the conclusion that, rather than using a large DC battery bank and inverters

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to power the instruments while underway in the van, towing a small Honda generator behind the van would be more practical. A towing ball was installed on the van, but funds were exhausted before the generator could be purchased.

### WORK PENDING

To complete the dynamic van test system, our most pressing need at WHOI is to receive continuation funds for engineering and computer programming support. Also essential is support for subcontracting the fabrication of the critically important prototype superconducting cryogenic gravity and gravity gradient sensors. The CDU link to the ASN-140 INS needs to be established, and would be best accomplished with a few days visit by the appropriate engineer from McAir. I anticipate that this could be arranged. A Honda (or equivalent) portable generator needs to be acquired and mounted on a small trailer to be towed behind the van. I also proposed to utilize a field-proven 5 1/4-inch WORM optical disc drive for real-time recording. The random access capability of this media and its permanence and data density recommend it. All the engineers that I have talked with at WHOI are presently overcommitted, and can only offer advisory time for this project. Thus, support for a full-time dedicated interim-level engineer and a few months per year support for an experienced engineer to advise and oversee the engineering involved would also be needed. This new engineer will be a U.S. citizen to whom the technical information on the ASN-140 or other INS systems can be shared. We seek guidance and help from Government and Industry sources as appropriate and reasonable.

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