INVESTIGATION OF AIR TRANSPORTATION TECHNOLOGY AT OHIO UNIVERSITY, 1984

Richard H. McFarland
Ohio University
Athens, Ohio

INTRODUCTORY REMARKS

The year 1984 was one of transition, change, and growth for the Joint University Program for Air Transportation at Ohio University. The Loran-C work changed direction from that of receiver hardware development to the operational development of Loran-C for enroute navigation and non-precision approaches. Mr. Stanley M. Novacki III returned from his intern residency at NASA Langley Research Center and continued his work on the DATAC data bus monitor. During the summer, participation in a promotional effort resulted in the Federal Aviation Administration joining NASA Langley Research Center in supporting this program. This partnership allowed for increased funding to the JUP universities and, at Ohio University, allowed for the formation of three new research areas: global positioning system test-bed receiver development; fiber optic data bus applications in general-aviation aircraft; and advanced remote monitoring techniques.

One of the last hardware upgrades to the Ohio University Loran-C receiver was performed under the direction of Dr. Robert W. Lilley. The Memory Aided Phase Locked-Loop (MAPLL) developed for the O.U. Loran-C receiver was modified to reduce the number of devices required to control the MAPLL and to improve the efficiency and speed of the 6502 MAPLL device driver software. These modifications have been documented by Lilley in Ohio University NASA TM 90 (ref. 1).

One of the operational problems with using the O.U. Loran-C receiver for enroute navigation studies was due to the calculation of heading and distance to waypoints with respect to true north as opposed to magnetic north. Rajan Kaul, a JUP graduate intern, implemented a magnetic variation model for the continental United States, in FORTRAN IV, on Ohio University's IBM 370 mainframe computer and then in the 6502 machine language for use in the O.U. Loran-C receiver. This work is discussed in further detail by Kaul in Ohio University NASA TM 91 (ref. 2).

Rajan Kaul made a second contribution to the study of the operational enroute capabilities of Loran-C in his master's thesis, "Comparison of Great Circle and Rhumb Line Flight Paths in the Continental United States Using Simulation and Test Flights," also published in Ohio University NASA TM 93 (ref. 3). This paper discusses the discrepancies encountered between the two route structures, particularly over large distances, and the possible conflicts which may arise with their simultaneous use in the national airspace.

The work on the DATAC data bus monitor was initiated by the second NASA Langley Research Center/Ohio University Internship and continued through the work of that intern appointee, Mr. Stanley M. Novacki, III.

Novacki developed a program downloader, plus other utility software, for the DATAC bus monitor unit (documented by Novacki in Ohio University NASA TM 92, ref. 4). His later work involved the development of necessary tools, which with the aforementioned utility programs, provided the working base to complete the DATAC data bus monitor unit.

One of the new areas of research involved the siting of the Ohio University Gordon K. Bush Airport for Loran-C non-precision (NP) approaches. Dr. Robert W. Lilley, Associate Project Director, and Mr. Daryl L. McCall, JUP Project Engineer, have performed most of the required surveying tasks. The results of the survey data will be used in the calculation of the final approach fix (FAF) and approach path for a Loran-C NP approach. It was planned that Lilley, McCall, and an intern would perform flight tests for the purpose of evaluating the defined NP approach path.

Another new area of work involved the development of a reconfigurable GPS receiver test-bed. Work had already begun through the efforts of JUP graduate intern Mr. Samuel J. P. Laube who implemented and tested some antenna designs for use at GPS frequencies. Also, Ohio University planned to receive, as an equipment grant from the FAA Technical Center, Atlantic City, NJ, the dual channel GPS receiver hardware developed by Stanford Telecommunications, Inc. Upon receipt of this hardware, work was to begin to make the unit airworthy as soon as possible. Flight tests of the dual channel receiver were planned to examine the enroute capabilities of GPS.

The new effort to develop a fiber optic data bus was begun through work by JUP undergraduate intern Mr. Steve Shreve. This work was enhanced by corporate gifts from Aero Mechanisms, Chatsworth, CA and Electrosonics, Columbus, OH. The supporting gift items consisted of two blind encoding altimeters, two digital altitude displays, and an encoding transponder. This equipment, which normally requires a twelve conductor data bus, was to be serially interconnected by a fiber optic cable. Once the fiber optic hardware was developed and laboratory tested, several flight tests/experiments were to be considered.

The third area of new work involved the application of image processing techniques to monitor facilities remotely, such as antenna arrays, whose operation may be sensitive to various unexpected obstructions (e.g. fallen trees, ground slippage, vehicles, etc.). This work was to involve the use of Ohio University's COMTAL Vision One image processor with either the University's IBM/370 or the Department of Electrical and Computer Engineering's VAX 11/750. Digitized photographs, and later, actual data from navaids sites, were to be used to develop and demonstrate processing and data transmission techniques for successful monitoring.

REFERENCES

1. PROCESSOR-CONTROLLED TIMING MODULE FOR LORAN-C RECEIVER, Robert W. Lilley, February 1984, OU NASA TM-90.

   Hardware documentation is provided for the modified Loran-C timing module, which uses direct software control in determining loop sample times. Computer loading is reduced by eliminating polled operation of the timing loop.

2. A MICROCOMPUTER-BASED SYSTEM TO COMPUTE MAGNETIC VARIATION, Rajan Kaul, March 1984, OU NASA TM-91.

   A microcomputer-based implementation of a magnetic variation model for the continental United States is presented. The implementation computes magnetic variation as a function of latitude and longitude for general aviation receivers such as Loran-C.

3. COMPARISON OF GREAT CIRCLE AND RHUMB LINE FLIGHT PATHS IN THE CONTINENTAL UNITED STATES USING SIMULATION AND FLIGHT TESTS, Rajan Kaul, November 1984 (M.S. Thesis), OU NASA TM-93.

4. A PROGRAM DOWNLOADER AND OTHER UTILITY SOFTWARE FOR THE DATAC BUS MONITOR UNIT,
   Stanley M. Novacki, III, July 1984, OU NASA TM-92.

   A set of programs designed to facilitate software testing on the DATAC Bus Monitor is described.