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LASER RANGING AND VERY-LONG-BASELINE INTERFEROMETRY FOR GEODETI--ETC(U)
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LASER RANGING AND VERY-LONG-BASELINE INTERFEROMETRY FOR GEODETIC APPLICATIONS

Irwin I. Shapiro and C. C. Counselman III

Department of Earth and Planetary Sciences
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

February 1978

Final Report
1 July 1974 - 30 September 1977

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: AFGL-TR-78-0057	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): Laser Ranging and Very-Long-Baseline Interferometry for Geodetic Applications.	5. TYPE OF REPORT & PERIOD COVERED: Final Rept. 1 Jul 74-30 Sep 77; 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Irwin I. Shapiro, C. C. Counselman, III	8. CONTRACT OR GRANT NUMBER(s): F19628-75-C-0058
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Department of Earth and Planetary Sciences, Massachusetts Inst. of Technology, Cambridge, MA 02139	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 61102F; 2309G101; G1
11. CONTROLLING OFFICE NAME AND ADDRESS: Air Force Geophysics Laboratory, Hanscom AFB, Massachusetts 01731, Monitor/Theodore E. Wirtanen/LWG	12. REPORT DATE: February 1978; 13. NUMBER OF PAGES: 4
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): 4 pp.	15. SECURITY CLASS. (of this report): Unclassified; 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

404 784

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Lunar
Laser
LAGEOS
Lunar libration
Very-long-base interferometry
Earth rotation
Onsala Space Observatory

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Three distinct tasks were undertaken to advance the application of space techniques to the measurement of geodetic parameters: (i) error analyses were performed to estimate the accuracy with which the locations of satellite tracking stations and the motion of the earth's pole may be determined from laser-ranging observations of the LAGEOS satellite; (ii) a numerical model of the moon's rotation was developed to support the analysis of lunar laser ranging

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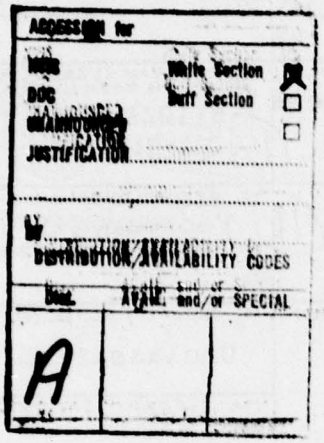
observations; and (iii) a very-long-baseline interferometry (VLBI) system was constructed and installed at the Onsala Space Observatory in Sweden for use in a program to monitor the earth's rotation through observations of extragalactic radio sources. The details of this work have been described in three previously published reports.



The work done under this contract falls primarily into three distinct categories: (i) error analysis of possible laser ranging to the then-proposed, now-orbiting LAGEOS satellite; (ii) development of a numerical model of the moon's libration; and (iii) the development and deployment of a dual frequency band receiver system for a very-long-baseline interferometer. We discuss our results only briefly below since we give reference to the appropriate reports which present fuller discussions of the individual subjects.

The error analysis of laser ranging to the LAGEOS satellite was undertaken to estimate the accuracy with which both the locations of the laser stations and the motions of the earth's pole could be determined. Five such analyses were performed to simulate the results obtainable with 14 laser stations employed to range to LAGEOS which was assumed to be in a polar, near circular orbit with 10,000 km semimajor axis. The determination of the laser sites typically had standard errors of about 2 cm; the corresponding uncertainties in the other components of the laser site coordinates and in the pole position of the earth typically ranged from about 2 to 10 cm. Further details are given in Reference 1.

In order to best analyze laser ranging observations of the moon to determine relevant geophysical information, we developed our accurate numerical model of the moon's libration. In particular, we developed the equations of motion, and the variational equations, for the moon's rotation in an inertial

coordinate system. The results were compared with a similar model, developed at JPL, that was referenced to a rotating coordinate system. The detailed derivation of the relevant equations and the partial derivatives, and the detailed comparison, is contained in Reference 2.

To measure accurately variations in the rotation of the earth with the technique of very-long-baseline interferometry (VLBI), we developed, constructed, and tested a dual frequency, S- and X-band receiver system similar to that described in Reference 3. This system was deployed at the Onsala Space Observatory in Sweden for initial test in late September, 1977. The test seemed to be successful, but the data analysis could not be completed before the end of this contract. The VLBI receiver system is, of course, intended for future use in a program to monitor the earth's rotation.

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