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Technical Comments

Spacecraft Radio-Occultation Technique for the Study of Planetary Atmospheres

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IN the 12th von Karman lecture,[1] Schurmeier presents a beautifully descriptive and inspiring account of this nation's program of planetary exploration. I applaud the total result, but wish to expand upon one point. On page 392 he notes that "A striking new technique...is radio oncultation measurements of atmospheric density...conceived shortly before the 1964 launch (of Mariner IV) by D.L. Cain of JPL...". He then goes on to discuss other aspects of the experiment and trajectory for the 1965 radio occultation measurements of the atmosphere and ionosphere of Mars. I believe that more should be said about this first demonstration involving radio occultation of planetary spacecraft, and in particular about the origins of the concept.

A sequence of numerous meeting papers and discussions, letters, proposals, and memos on the subject of "bistatic radar astronomy" was begun by Stanford colleagues and myself in 1960. This phrase was defined in terms of several space radioscience experiments made possible by the use of propagation between two radio terminals, one on Earth and one on a spacecraft near a planetary target One such experiment is radio occultation for the study of planetary atmospheres and ionospheres. (This differs from earlier optical and radio star occultation experiments in that it is based upon the use of a point source of coherent radiation, so that signal frequency as well as intensity is an observable.) For example,I discussed this field at the June 1960 meeting at JPL on electromagnetic studies of the moon and planets, and introduced the subject at the Space Science Summer Study of the National Academy of Sciences held at the State University of Iowa in June-August 1962.[2] Also in 1962, Gunnar Fjeldbo began working on his Stanford PhD dissertation, which was to include a very detailed analysis of the radio occultation concept emphasizing the study of planetary ionospheres and surfaces.[3] That same year we initiated what became a continuing discussion with JPL and NASA representatives on the subject of spacecraft trajectories designed for occultation experiments, and work was started at Stanford on dual-frequency equipment for such studies.

It appears that the statement by the author which is quoted above must refer to the implementation of the experiment for Mariner IV and not to the basic radio occultation concept. I agree that Cain and his colleagues at JPL made original contributions which were of fundamental importance for the conduct of this initial experiment. They conceived and developed the technique that used the JPL coherent counted doppler system to analyze the planetary atmosphere during an occultation. This technique enabled a direct determination of the refractivity of the neutral atmosphere and it did not require additional flight equipment, thus making an occultation experiment feasible on Mariner IV. However, with reference to radio occultation as a method for the study of planetary atmospheres and ionospheres, I would distinguish conception of the method from conception of a technique for implementing the method, with the former taking place several years earlier.

Received April 23, 1976; revision received Aug. 17, 1976
Index categories; Atmospheric, Space, and Oceanographic Sciences; Lunar and Planetary Spacecraft Systems, Unmanned; Spacecraft Mission Studies and Economics.

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Errata

Estimation of Satellite Lifetime from Orbital Failure Experience

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[JSR, **13**, 75-81 (1976)]

FIGURE 5 at the bottom of column one on page 79 was improperly captioned. The correct caption is:

Fig. 5 Probability of launch for random truncation and random failure rate factors.

Received June 28, 1976.
Index category: Reliability, Quality Control, and Maintainability.

Announcement: 1976 Author and Subject Index

The indexes of the four AIAA archive journals (*AIAA Journal, Journal of Spacecraft and Rockets, Journal of Aircraft,* and *Journal of Hydronautics*) will be combined and mailed separately early in 1977. In addition, papers appearing in volumes of the *Progress in Astronautics and Aeronautics* book series published in 1976 will be included. Librarians will receive one copy of the index for each subscription which they have. Any AIAA member who subscribes to one or more Journals will receive one index. Additional copies may be purchased by anyone, at $10 per copy, from the Circulation Department, AIAA, Room 730, 1290 Avenue of the Americas, New York, New York 10019. **Remittance must accompany the order.**

Ruth F. Bryans
Director, Scientific Publications