Reply by Author to D. H. Platus

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IN replying to the comments of D. H. Platus the following statements can be made:

1) The basic differential equations (1) and (2) of Ref. 1 for total angle of attack and windward meridian in terms of the vehicle's roll, pitch, and yaw rates were integrated for a number of inputs provided from actual flights, and the results compared with other, more complex methods for determining δ and μ. References 2 and 3 contain some of the results of these comparisons. These results were found to be very satisfactory; thus, for example, it is stated in Ref. 3 that angle of attack extremes differ by less than 0.14 sec in time, and by less than 0.10° in value.

2) The approximations (21) and (25) for the average values $\bar{\delta}$ and $\bar{\nu}$ of Ref. 1 are based on Eqs. (1) and (2). These approximations were recently utilized for a flight that exhibited nearly circular motion, and the results were compared[4] again with results obtained from other more complex methods. Again, the results of these comparisons are very satisfactory; the differences $|\bar{\delta} - \delta|$ and $|\bar{\nu} - \nu|$ are less than 1° and 1°/sec, respectively, at all pertinent altitudes during re-entry.

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3) For the type of re-entry vehicles considered in the applications[2-4] the total lateral rate exhibits a rapid rise starting from near zero values at re-entry, assumes a maximal value above about 150 kft, and then goes to zero with the total angle of attack. Equations (12) of the Comment for $\bar{s}_\pm$ do not portray this behavior; in the table contained in the Comment both $\bar{s}_+$ and $-\bar{s}_-$ are monotonically increasing functions. The author has not encountered ballistic vehicles whose total lateral rate during re-entry shows the latter type of behavior.

4) In summary, then, it may be stated that for the cases tested the more exact Eqs. (1) and (2), and the approximations (21) and (25) are capable of providing satisfactory answers. The purpose of the considerations leading to these equations was the development of efficient yet sufficiently accurate methods for calculating total angle of attack and total lateral rate, rather than the exhibition of great theoretical profundity.

References

[1] Lotkin, M. M., "Angle of Attack and Lateral Rate for Nearly Circular Re-Entry Motion," *Journal of Spacecraft and Rockets*, Vol. 7, No. 5, May 1970, pp. 628–631.

[2] Lotkin, M., "Total Angle of Attack by Accelerated Procedure," GE-MSD Flight Operations Laboratory Memo 695, Sept. 1967, General Electric Co., Philadelphia, Pa.

[3] Lotkin, M., "Total Angle of Attack for 201, 4B," GE-MSD PIR 8239-070, Dec. 1968, General Electric Co., Philadelphia, Pa.

[4] Lotkin, M., "Approximations for Total Angle of Attack and Total Lateral Rate for 208," GE-RESD PIR 8239-2154, Aug. 1970, General Electric Co., Philadelphia, Pa.

Announcement: 1970 Author and Subject Indexes

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 1971. Subscribers are entitled to one copy of the index for each subscription which they had in 1970. Extra copies of the index may be obtained at $5 per copy. Please address your request for extra copies to the Circulation Department, AIAA, Room 280, 1290 Avenue of the Americas, New York, New York 10019.

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