AD-A140 008 ON THE STABILITY OF FLIGHT VEHICLES IN THE LOW REYNOLDS NUMBER NON-LINEAR..(U) MASSACHUSETTS INST OF TECH CAMBRIDGE GAS TURBINE AND PLASMA D.. E E COVERT ET AL. 1/1

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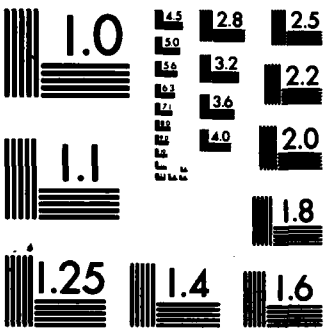

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A FINAL REPORT

on

ONR CONTRACT NO: N00014-82-K-0310

entitled

ON THE STABILITY OF FLIGHT VEHICLES IN THE LOW REYNOLDS NUMBER NON-LINEAR REGIME

prepared for

Department of the Navy
Office of Naval Research, Code 432F
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The work reported herein was carried out on this grant during its active life, that is from September 1981 to September 1983. The primary effort may be divided, for the purpose of this discussion, into three parts. The first part consists of a literature survey in external fluid mechanics, (i.e., flow over wings and bodies) in the Reynolds number range of 20,000 to 200,000.[1] ~~This work~~ was summarized at the ONR-Supervised Workshop on Low Reynolds Numbers Flow in February 1983. The second part was a technical review of the material presented at ~~that workshop~~.[2] The third ~~and last~~ part was a trajectory study for a vehicle flying in the low Reynolds number regime.[3] The trajectory study was initiated as a means of accessing the stability of a vehicle flying under circumstances where (a) the aerodynamic characteristics are non-linear and (b) there is coupling between lateral motion (which can induce local stalling) and pitching motion. It is found that for the case studied a modified form of the Liapunov Stability Criteria using a phase-plane, provided a suitable description of the motion. The unstable lateral motion of the vehicle chosen for analysis is shown, ~~in figure 1.~~ The instability is indicated by steady growth of the curve away from any particular point shown on the plane. This work is incomplete in that time did not permit study of reverse interesting features; like the effect of lift curves hystersis on the motion.

Copies of references 1 and 3 are enclosed herewith.

REFERENCES

(1) "Low Speed Aerodynamics in The Reynolds Number Range of 20,000 to 200,000," MIT Aero Dept. Report by E. E. Covert and M. Drela, Feb. 1983.

(2) Letter from E. E. Covert to Dr. Dean Mook, Fluid Dynamics Group/ Code 432, ONR dated Feb. 9, 1983.

(3) "On the Stability of Flight Vehicles in the Low Reynolds Number Non-Linear Regime," MIT Aero Dept Report by Otto W. K. Lee, Carol Vaczy and Eugene E. Covert, Jan. 1984.

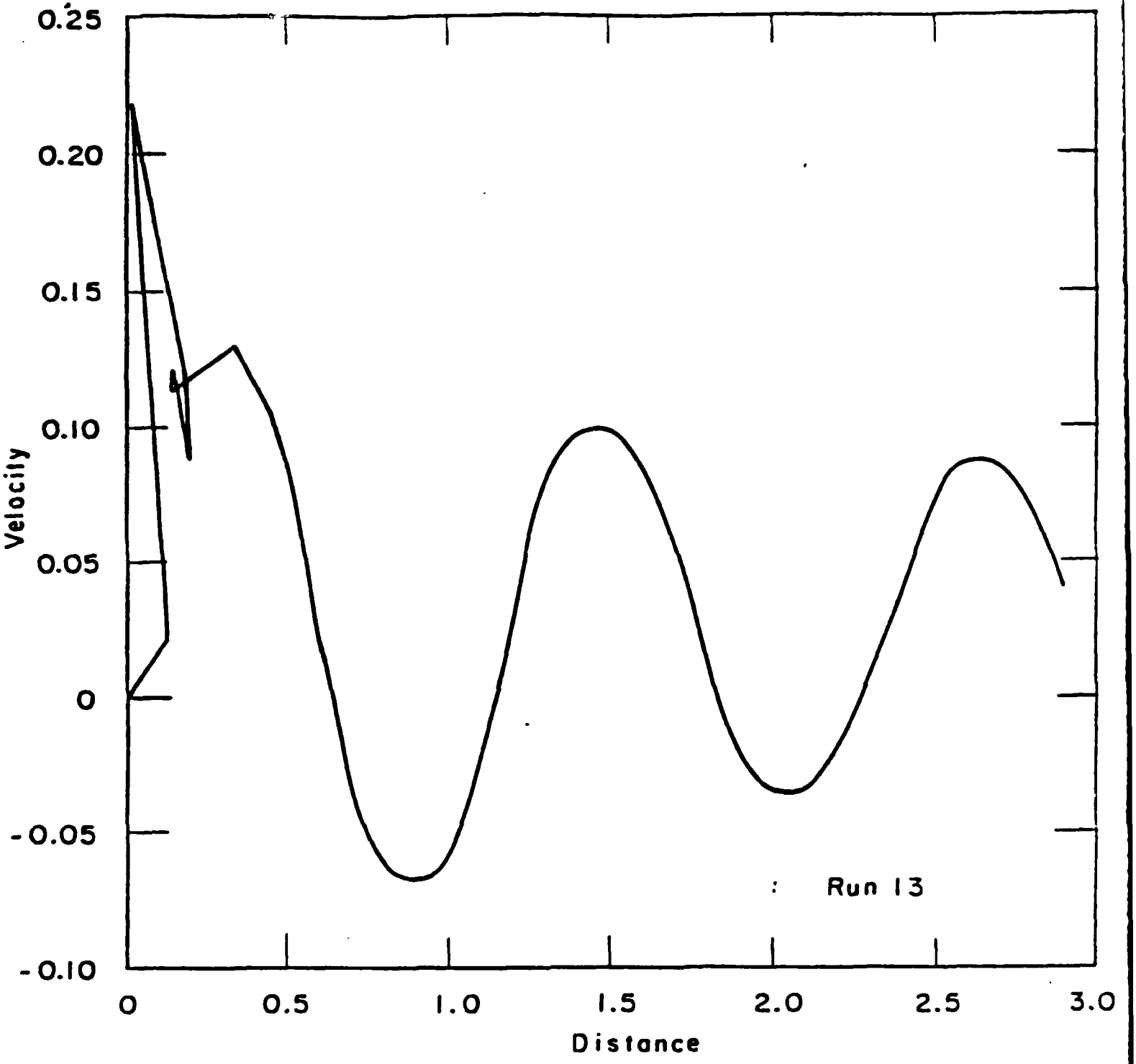

FIG. 1 LIAPUNOV STABILITY $C_L = 2.33$ INITIAL OFF SET 2° YAW