$$\frac{d\phi}{dr} + \frac{\tan\phi}{r}\left(1 + \frac{d\ \ln T}{d\ \ln r}\right) - \frac{w}{2T\cos^2\phi}$$

from which follows the necessary condition

$$dT/dr = w/2\ \sin 2\phi$$

The last relation determines the manner in which T varies if static equilibrium exists. Thus the paradox appears to be resolved; the more difficult problem of determining the shape of the film remains.

References

[1] Gellatly, R. A., "A note on a soap-film paradox," J. Aerospace Sci. **29**, 1487 (1962).

[2] Adam, N. K., *The Physics and Chemistry of Surfaces* (Oxford University Press, London, 1941), 3rd ed., Chap. III.

Comments on "The Adjoint Method and Its Application to Trajectory Optimization"

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A STUDY of the problem of a minimum time transfer between two coplanar circular orbits assuming a constant thrust acceleration has been made, utilizing the Gradient Technique.[1] Optimal steering programs were obtained for values of (thrust acceleration)/(initial gravitational acceleration) from 0.05 to 3.0 and for (radial transfer distance)/(initial orbit rad) values from 0.05 to 1.0. Numerous initial steering programs were used, including those of the form presented by Faulders[2] and by Jurovics and McIntyre.[3] In all cases, the optimal steering programs obtained were of the form presented by Faulders. Thus the solution presented by Jurovics and McIntyre appears to be erroneous.

For the values of distance ratio (0.5) and acceleration ratio (0.166667) considered by Faulders, a (minimum transfer time)/(time per radian in initial orbit) equal to 3.20608 was obtained. This is substantially in agreement with Faulders' value.

For the values of distance ratio (0.1628) and acceleration ratio (1.7343) considered by Jurovics and McIntyre, a (minimum transfer time)/(time per radian in initial orbit) equal to 0.60946 was obtained. This is a substantial improvement over their solution.

The terminal constraint errors for each of the foregoing solutions were less than $3 \times 10.^{-5}$

Solutions have been obtained using an analog computer as well as the IBM 7090.

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References

[1] Bryson, A. E. and Denham, W. F., "A steepest-ascent method for solving optimum programming problems," Raytheon Co. BR-1303 (August 10, 1961).

[2] Faulders, C. R., "Minimum time steering programs for orbital transfer with low thrust rockets," Astronaut. Acta **3**, Fasc. 1 (1961).

[3] Jurovics, S. A. and McIntyre, J. E., "The adjoint method and its application to trajectory optimization," ARS J. **32**, 1354–1358 (1962).

Errata: Damping of a Gravitationally Oriented Two-Body Satellite

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THE following errors occurred in Ref. 1:

In expressions [1–3], replace $t_0/T \leq$ by $t_0/T \geq$.

The sentence preceding inequality [1] should read: "The principal result of the paper is the following upper bound on damping rate (lower bound on damping time):"

In the line preceding inequality [2], "upper bound" should be changed to "lower bound."

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[1] Zajac, E. E., "Damping of a gravitationally oriented two-body satellite," ARS J. **32**, 1871–1875 (1962).