Technical Comments

Comment on "Euler's Rotational Equations for Bodies with the Inertia Varying due to Mass Redistribution and Mass Loss"

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EQUATIONS (15–17) contain the symbols p, q, and r, and it is clear from the context that these represent scalar components of the angular velocity vector $\bar{\omega}$ which appears in Eq. (14). However, no indication is given as to how one finds the angular velocity of a nonrigid body. The meaning of Eqs. (15–17) is thus somewhat obscure, and their utility questionable.

Reference

[1] Hrushow, W. K., "Euler's Rotational Equations for Bodies with the Inertia Varying due to Mass Distribution and Mass Loss," *AIAA Journal*, Vol. 7, No. 2, Feb. 1969, pp. 337–339.

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Reply by Author to T. R. Kane

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EQUATIONS (15–17) describe the case of torque-free (should be $\bar{M} = \bar{0}$) mass redistribution, with material particles displaced in an arbitrary manner along radial directions ($\bar{r}$, $\dot{\bar{r}}$, and $\ddot{\bar{r}}$ are collinear). For the torque-free ablation case analyzed in the subject Note, released particles also remain along their original radial directions. This is the reason for considering not the most general case of $\dot{\bar{r}}$ and $\ddot{\bar{r}}$ along any arbitrary direction in Eqs. (15–17). In this case, the angular velocity of the body in steady state would be the same as that of a corresponding rigid body having the same mass distribution. Introduction of arbitrary directions for $\ddot{\bar{r}}$ would make Eqs. (15–17) more complex because of the presence of the torque ($\bar{M} \neq \bar{0}$) and, as T. R. Kane correctly indicates, would obscure the meaning of angular velocity. However, it would not modify general conclusions of the subject Note. Because motion of particles along radial directions occurs in any arbitrary manner, the given form of Eqs. (15–17) is considered to be sufficiently general for the purpose of the subject Note, which was intended only to show the difference between Euler's formulations for mass redistribution and mass loss for otherwise similar conditions. This point, however, was not sufficiently explained in the subject Note. An explanatory footnote would have been helpful.[1]

Reference

[1] Hrushow, W. K., "Errata: 'Euler's Rotational Equations for Bodies with the Inertia Tensor Varying due to Mass Redistribution and Mass Loss'," *AIAA Journal*, Vol. 8, No. 2, Feb. 1970, p. 384.

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