The Stability of Tumbling Modes of Heavy Plate in a Resisting Medium

Mikhail Garbuz

Steklov Mathematical Institute of RAS, Moscow, Russia

We consider the free fall of a thin heavy plate in a fluid. The motion is described by Kirchhoff equations [1] with additional terms that correspond to viscous friction. In [2], among the possible steady-state movements, the so-called tumbling regimes were described. On these regimes, the center of mass descends on average in a straight line at a certain angle to the horizon, and the plate rotates around the lateral axis with a constant average angular velocity. The objective of this work is to study the stability of such modes with respect to possible displacements along the axis of rotation.

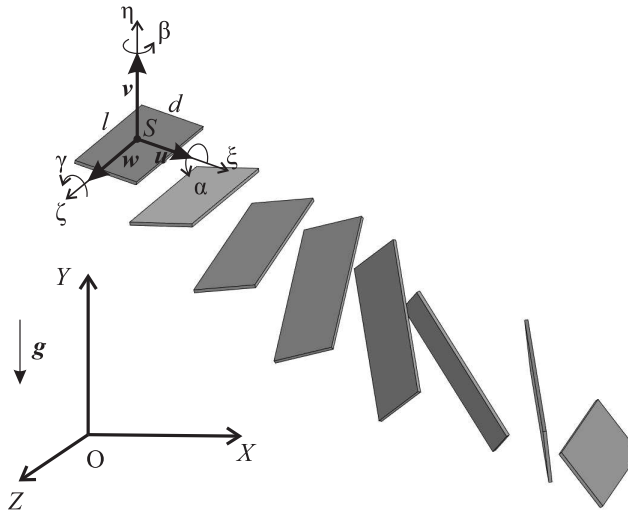

Figure 1. Position of the plate.

The problem will be reduced to studying the stability of the zero solution of the Hill equation: $\theta'' + p(t)\theta = 0$, where $p(t)$ is a π-periodic function. The stability condition will depend on the geometric and inertial characteristics of the plate.

References

[1] Kirchhoff G., Ueber die Bewegung eines Rotationskörpers in einer Flüssigkeit, *Reine und Angewan. Math.*, 1869, vol. 71, pp. 237–262.

[2] Kozlov V. V., On a problem of a heavy rigid body falling in a resisting medium, *Vestn. Mosk. Univ., Ser. Mat. Mekh.*, 1990, vol. 29, no. 1, pp. 79–86.