Two-mass gyro-particle as the tool for supersonic aeroelasticity analysis

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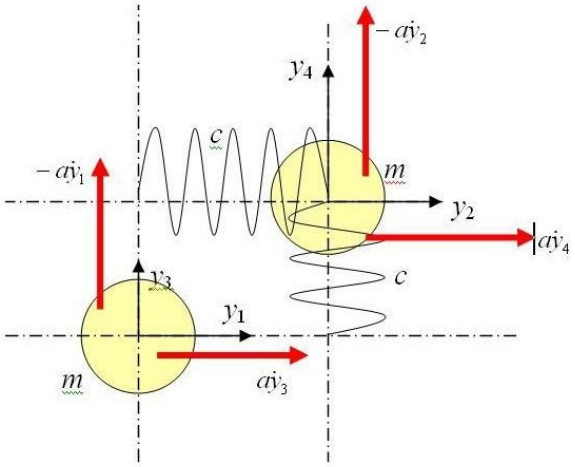
ABSTRACT

If the vehicle flies at a high supersonic speed, then plazma is available. Then it is difficult to use traditional piston theory (and its modifications) [1] for solving the vehicle aeroelasticity problem. This work presents the idea of considering the incident supersonic airflow as the system of interacting two-mass gas gyro-particles. See the particle in the picture. This particle can split in two opposite electric charges and ionize the incident airflow.



The concept of the single-mass gyro-particle is presented in [2].

The considered two-mass gas gyro-particle has the elastic elements and the two pairs of multiple oscillation frequencies. The incident gas gyro-particles interact with the structural particles of the elastic vehicle body. The gas particles start to rotate and oscillate. The multiple oscillation frequencies split. The higher the vehile speed, the larger the gap between the oscillation frequencies of the gas particle. The resonance takes place when the gas particle oscillation frequency gets into the vicinity of a natural frequency of the elastic structure. It is the flutter.

It is assumed that the supersonic nature of the incident airflow is determined not by the vehicle speed, but by the gas gyro-particle rotation frequency. The higher the rotation frequency, the higher the available aerodynamic drag. If the gyro-particle rotation frequency is high enough, then the vehicle decelerates and goes upside down. It is the aeroelastic divergence.

The problem is considered using the 2D-approach.

REFERENCES

[1] B.J. Thuruthimattam, P.P. Friedmann, J.J. McNamara, and K.G. Powell *Aeroelasticity of a generic hypersonic vehicle*, Proceedings of the 43d AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 April 2002, Denver, Colorado, pp.1-14.

[2] Аринчев С.В. *Теория колебаний неконсервативных систем*, Москва, Издательство Московского Государственного Технического Университета имени Н.Э. Баумана, 2002, 464 стр.