SELECTED TOPICS

In Aerospace Engineering

EDITOR

ERWIN SULAEMAN

IIUM Press

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68100 Batu Caves
Selangor Darul Ehsan
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

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30.1. Introduction

Application of the theoretical aerodynamic and structural dynamic method discussed in the previous chapters is presented in this chapter. The field analyzing the interaction between structural deformation and aerodynamic loading has been renowned as aeroelasticty. Aeroelasticity takes into account the structural flexibility on the vehicle structure, its inertial masses, its influence to the surrounding air in the form of self-induced aerodynamic load and transient load, which may lead to structural instability problem.

30.2. The Flutter Solution Method

Aeroelasticity has been known as a mutual interaction of inertial and elastic structural forces and aerodynamic forces. The aerodynamic forces can be in the form of self-excited aerodynamic forces induced by structural deformation, or in the form of external disturbance forces. In terms of a discrete system, the equation of motion of the aeroelastic system can be derived based on the equilibrium condition of the aforementioned forces, i.e.:

$$\mathbf{M}\,\ddot{x}(t) + \mathbf{K}\,x(t) - \mathbf{F_a}(x) = \mathbf{F_e}(t) \tag{30.1}$$

where **M** and **K** are the mass and stiffness matrices respectively, and $\mathbf{F_a}$ and $\mathbf{F_e}$ are the self-excited and external aerodynamic forces respectively. In the present work the mass and stiffness matrices are generated by the structural finite element method as described in Chapters 22 and 23, and the self excited aerodynamic force is generated