SELECTED TOPICS

In Aerospace Engineering

EDITOR

ERWIN SULAEMAN

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

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IMPROVED DOUBLET POINT METHOD

27.1. Introduction

This chapter describes application of the theoretical kernel function presented in Chapters 19 and 20 to formulate unsteady aerodynamic of multiple interfering lifting surfaces. A summary of procedure to improve the doublet point method (DPM) of [38] and [34] is presented. The improvement is applied to the planar lifting surface configuration, and is extended to the non-planar configurations. The numerical singularity problems of both configurations are first identified, and then the solution procedures are described and compared with the original solution of Ueda and Dowell [38]. The series presented here is related to expansion series described in Chapters 20 and 22.

27.2. Present DPM for Planar Lifting Surfaces

The basic concepts of the original DPM are used here. The surfaces are divided into small trapezoidal elements as shown in Fig. 27.1. The lifting pressure is assumed to be concentrated at the doublet point located at the quarter chord along the midspan of each panel. The control point is placed on the three-quarter chord at midspan of each element.

If the doublet point and the control point are located at elements i and j respectively, then the aerodynamic operator may be written as

$$\Im_{ij} = \frac{\Delta S_i}{8\pi} K\left(x_i - \xi_j, y_i - \eta_j, z_i - \zeta_j, k, M\right) \tag{27.1}$$

where the kernel function is based on Landahl's formula [28]: