AEE 556 — Compressible Flow

Department of Mechanical and Aerospace Engineering

Homework 1

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Contents

Nomenclature

A	=	amplitude of oscillation
a	=	cylinder diameter
C_p	=	pressure coefficient
Cx	=	force coefficient in the x direction
Cy	=	force coefficient in the y direction
c	=	chord
dt	=	time step
Fx	=	X component of the resultant pressure force acting on the vehicle
Fy	=	Y component of the resultant pressure force acting on the vehicle
f, g	=	generic functions
h	=	height
i	=	time index during navigation
j	=	waypoint index
K	=	trailing-edge (TE) nondimensional angular deflection rate

1 Problem 1

In an inviscid flow, a small change in pressure dp, is related to a small change in velocity, du, by

$$dp = -\rho u du$$

which is referred to as Euler's equation and is derived from the conservation of momentum.

1.1

Using this relation, derive a differential relation for the fractional density change d / as a function of the fractional change in velocity du/u, with the fluid's compressibility as a coefficient.

1.2

$\frac{\mathrm{d}c}{\mathrm{d}x}$

1.3

1.4

1.5

1.6

2 Problem 2

2.1 Problem Statement

3 Problem 3

3.1 Problem Statement

Appendix A Problem 1 Python Code

Appendix B Problem 2 Python Code

Appendix C Problem 3 Python Code