

空气动力学 TD1 实验

Stu. Name		Stu. ID		Class Num.	
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Lab	202\204		Date	2014.11.6	
Course Name	Basic Fluid mechanics and aerodynamics				

1. Experimental Purposes

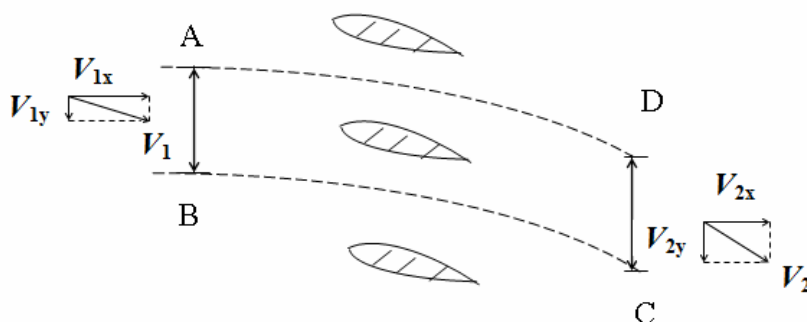
- (1) 了解航空发动机中空气动力学流动机理及做功形式；
- (2) 观察航空发动机工作过程中速度及压力的变化；
- (3) 完成叶片气动力及发动机推力的计算。

2. Experimental Environment

WESSTT CS/BV、WESSTT SEV、WESSTT HP

3. Question

(1) Some blades in a turbo-engine, find the aero-force on the blade according to the figure below.



解： $\Sigma F_x = \dot{m}(V_{2x} - V_{1x})$ ，设进出口面积为 s

$$p_1 s - p_2 s + F_x = \dot{m}(V_{2x} - V_{1x})$$

由连续方程： $\dot{m} = \rho s V_{1x} = \rho s V_{2x}$ ，即： $V_{1x} = V_{2x} = V_x$

$$F_x = \dot{m}(V_{2x} - V_{1x}) + (p_2 - p_1)s = (p_2 - p_1)s$$

同理 $\Sigma F_y = \dot{m}(V_{2y} - V_{1y})$ ，得到 $F_y = \dot{m}(V_{2y} - V_{1y})$



由伯努力方程: $p_1 - p_2 = \frac{\rho}{2} [(V_{2x}^2 + V_{2y}^2) - (V_{1x}^2 + V_{1y}^2)] = \frac{\rho}{2} (V_{2y}^2 - V_{1y}^2)$

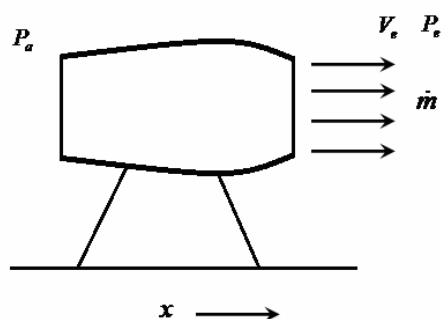
$$\begin{cases} F_x = \frac{\rho}{2} (V_{2y}^2 - V_{1y}^2) s, \text{ 说明叶片越弯, 做功量越大。} \\ F_y = \rho s V_x (V_{2y} - V_{1y}) \end{cases}$$

(2) In a ground test of a jet engine, find the thrust force.

$$P_a = 1.0133 \times 10^5 \text{ N/m}^2, A_e = 0.1543 \text{ m}^2$$

$$P_e = 1.141 \times 10^5 \text{ N/m}^2, V_e = 542 \text{ m/s}$$

$$\dot{m} = 43.4 \text{ kg/s}$$



解:

$$F = -[\dot{m}(V_{out} - V_{int}) + (P_{out} - P_{int})A_{in}]$$

$$V_{int} = 0 \text{ m/s}$$

$$F = -25 \text{ kN}$$

注: 双面打印。