106學年度機械系精進程式設計競賽之活動公告

競賽主題組別：流體力學相關應用

競賽日期：2017/11/28　10:00-12:00

競賽地點：E2-308(電腦教室)

公告得獎日期：2017/11/29

評分標準：

1. 程式碼與結果 55%

2. 作圖 30%

3. 作答時間 15%

獎項名額：

第一名：10000元（一組）、每位成員獎狀乙紙

第二名：5000元（一組）、每位成員獎狀乙紙

第三名：3000元（一組）、每位成員獎狀乙紙

佳作：數組、每位成員獎狀乙紙

需繳交資料：獲第一、二、三名獎之組別需在11/29當天下午5點前繳交下列資料，始得領獎:

1. 書面報告及心得（報告內容含題目、流力相關知識、如何使用Matlab程式來解題、畫圖等等）

2. 海報電子檔(一支隊伍一張海報)

3. 簡報電子檔(一支隊伍的簡報以5頁為限)

示範題：

A velocity field of a flow is given by $V = (0.3 + x)\hat{\imath} + (0.4 - y)\hat{\jmath}$ for $0 \leq x \leq 1, 0 \leq y \leq 1$ and the step size = 0.1. (a) Please plot the corresponding streamlines and the velocity field. (b) Please calculate the corresponding vorticity in the z-direction using central differentiation from the surrounding 8 points (descriptions are given below).

Solution, descriptions, and codes are given below.

Velocity vector field
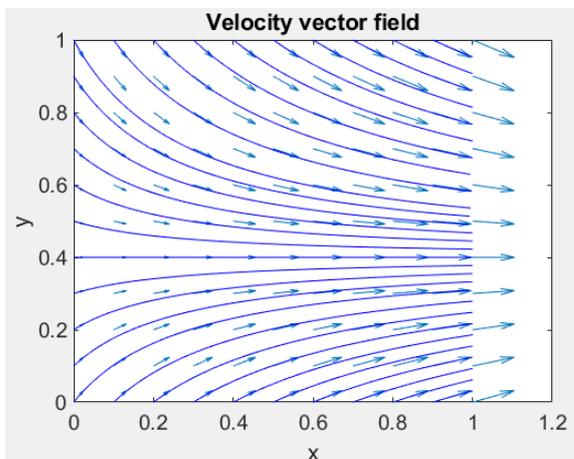
[2] Lines 2-3 generate a 2-D grid in the x-y space. Line 4 calculates the velocity field according to the equations in [1]. The function quiver(X,Y,U,V) in line 5 plots the velocity field (u, v) as arrows; each arrow locates at (x, y).

The function stream2(X,Y,U,V,sx,sy) in line 8 calculates the streamlines SL, a cell array. The coordinates of the starting positions of the streamlines are specified in sx and sy, which are prepared in lines 6-7. The function streamline(SL) (line 9) then plots the streamlines SL, as shown in [3]. We'll demonstrate the animation of the flow using the function streamparticles in Example06_02a.m, page 258.

```
clear
x=0:0.1:1;
y=0:0.1:1;
[X,Y]=meshgrid(x,y);
U=0.3+X;
V=0.4-Y;
quiver(X,Y,U,V)
sx=[0:0.1:1, zeros(1,11), 0:0.1:1];
sy=[zeros(1,11), 0:0.1:1, ones(1,11)];
SL=stream2(X,Y, U,V, sx,sy);
streamline(SL)
figure(1)
hold on
xlabel('x','fontsize', 14)
ylabel('y','fontsize', 14)
set(gca,'fontsize',14)
box on
title('Velocity vector field')
```
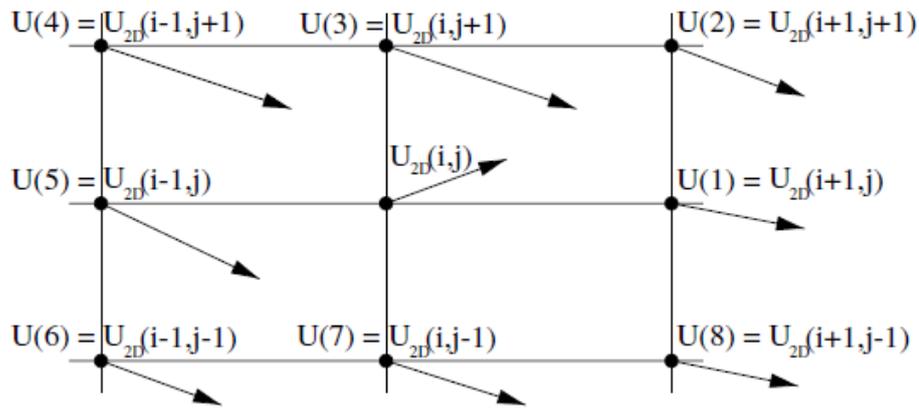
Table 5.14 Streamline Plots Functions

Functions	Description
streamline(SL)	Streamline plot
SL = stream2(X,Y, U,V, Sx,Sy)	Calculate 2-D streamlines
SL = stream3(X,Y,Z, U,V,W, Sx,Sy,Sz)	Calculate 3-D streamlines
Details and More: Help>MATLAB>Graphics>2-D and 3-D Plots>Surfaces, Volumes, and Polygons> Volume Visualization>Vector Volume Data	

計算渦度方法 (中央差分法)：

由外圍 8 個點的速度能求得中央位置近似的渦度。

$U(4) = U_{2D}(i-1,j+1)$ $U(3) = U_{2D}(i,j+1)$ $U(2) = U_{2D}(i+1,j+1)$

$U(5) = U_{2D}(i-1,j)$ $U_{2D}(i,j)$ $U(1) = U_{2D}(i+1,j)$

$U(6) = U_{2D}(i-1,j-1)$ $U(7) = U_{2D}(i,j-1)$ $U(8) = U_{2D}(i+1,j-1)$

$$(\omega_Z)_{i,j} \;\widehat{=}\; \frac{\Gamma_{i,j}}{4\Delta X \Delta Y} \;=\; \frac{1}{2}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$$

with

$$\Gamma_{i,j} = \frac{1}{2}\Delta X (U_{i-1,j-1} + 2U_{i,j-1} + U_{i+1,j-1})$$
$$+\frac{1}{2}\Delta Y (V_{i+1,j-1} + 2V_{i+1,j} + V_{i+1,j+1})$$
$$-\frac{1}{2}\Delta X (U_{i+1,j+1} + 2U_{i,j+1} + U_{i-1,j+1})$$
$$-\frac{1}{2}\Delta Y (V_{i-1,j+1} + 2V_{i-1,j} + V_{i-1,j-1})\,.$$