基于K-ε湍流模型添加用户自定义子模型

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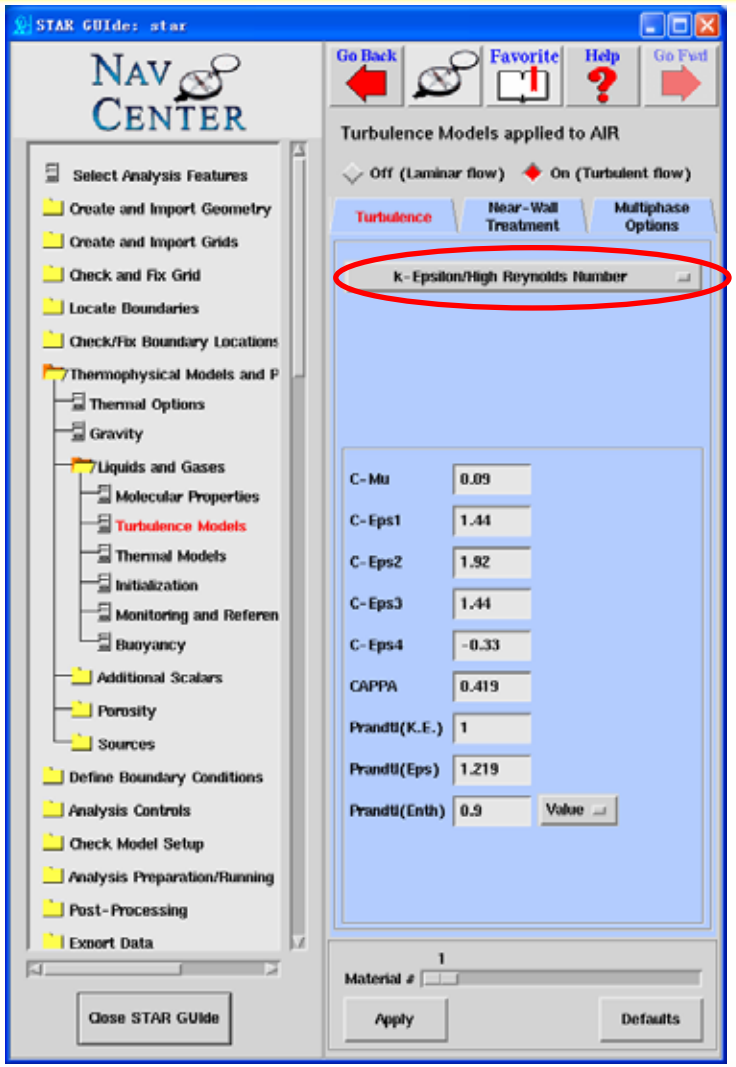
CDAJ
for digital solution

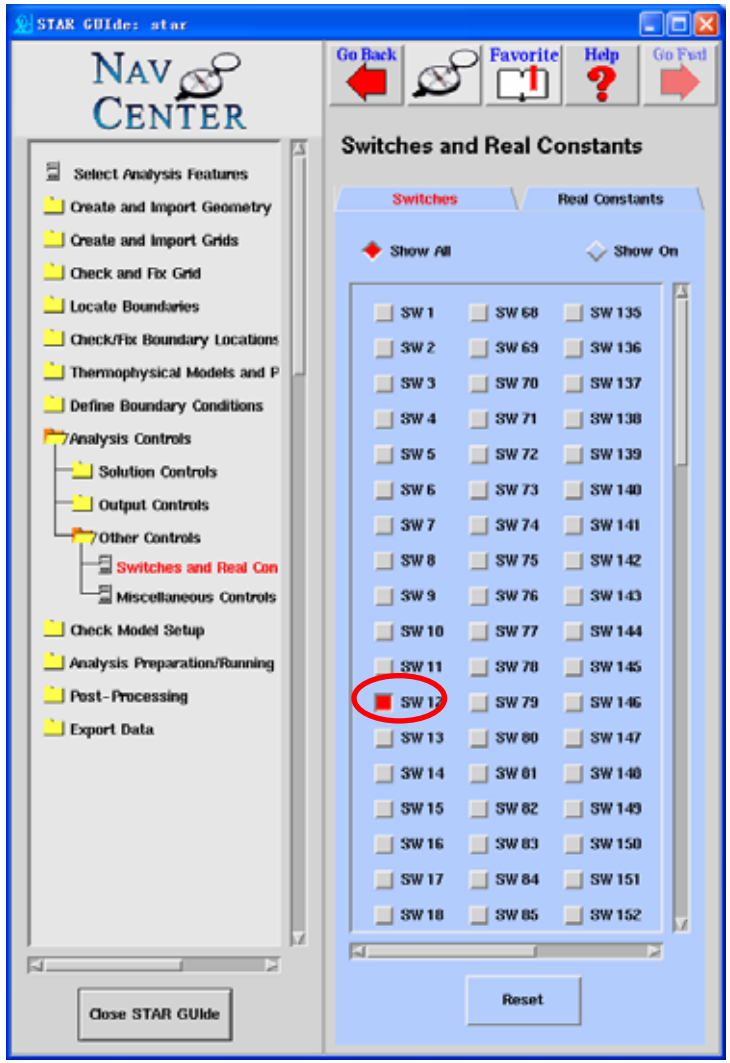
1. 设置High Re k-ε湍流模型



2. 设置Switch 12

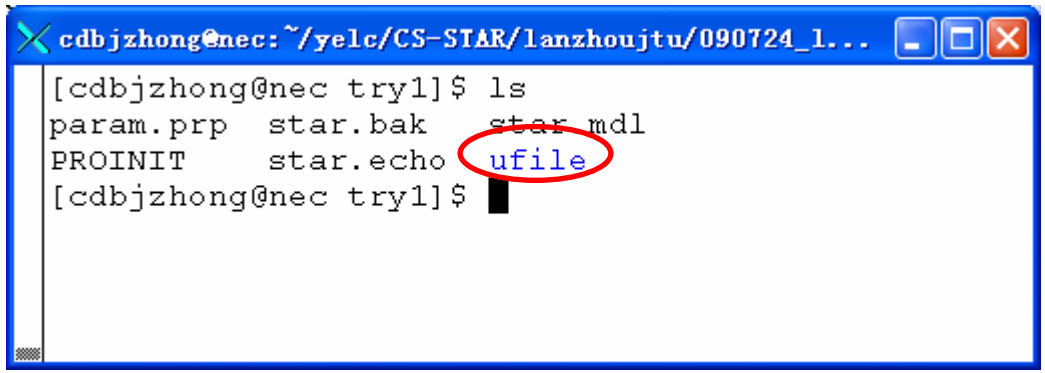
SWITCH 12 Y: User routine for turbulent viscosity is used for k-eps model and its variants.

基于标准 $k-\varepsilon$ 模型的MMK模型和DURBIN模型， ν_t 的表达式有变化，打开Switch 12来设定 ν_t 新的表达式

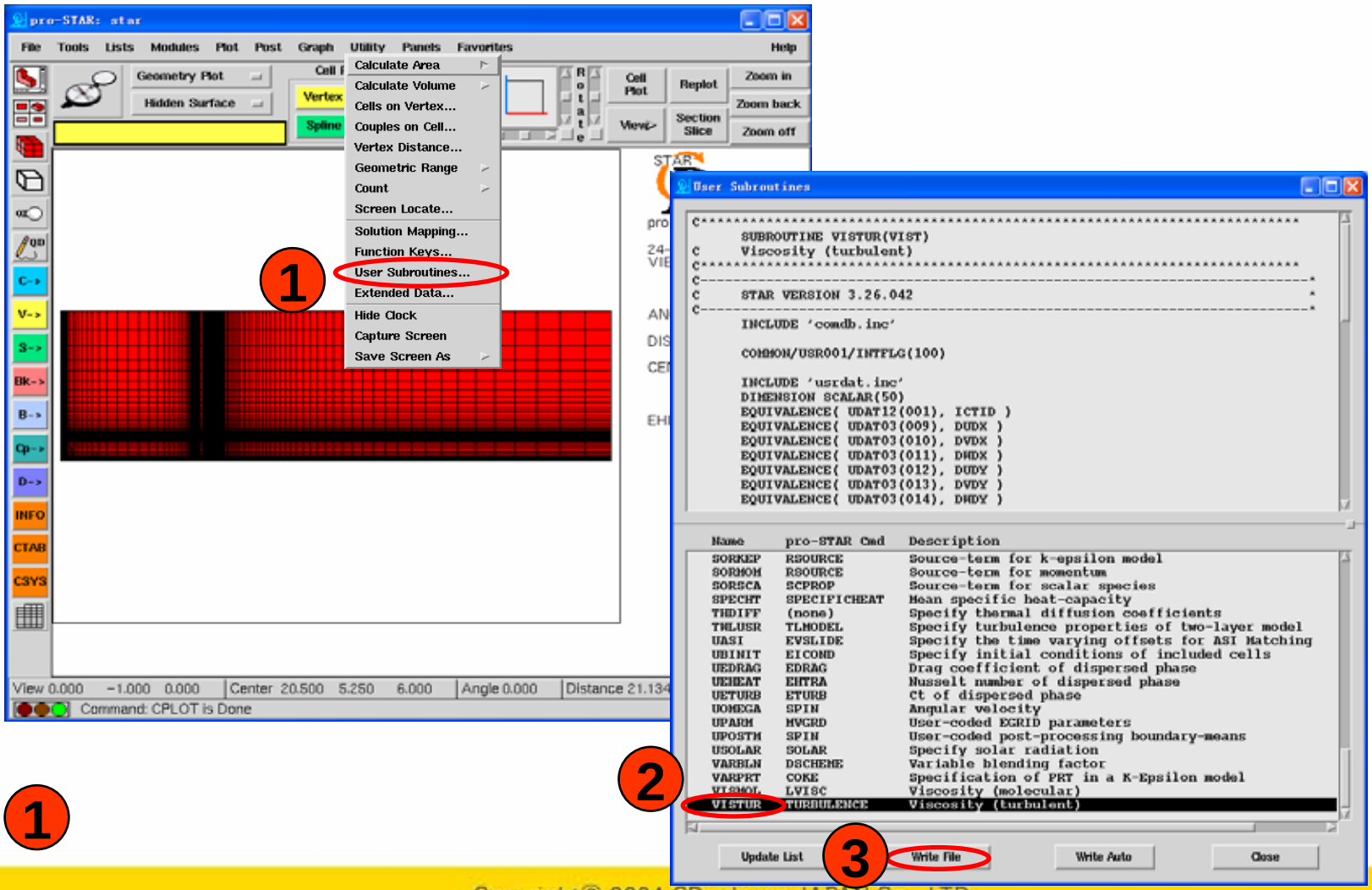


3. 生成ufile文件夹

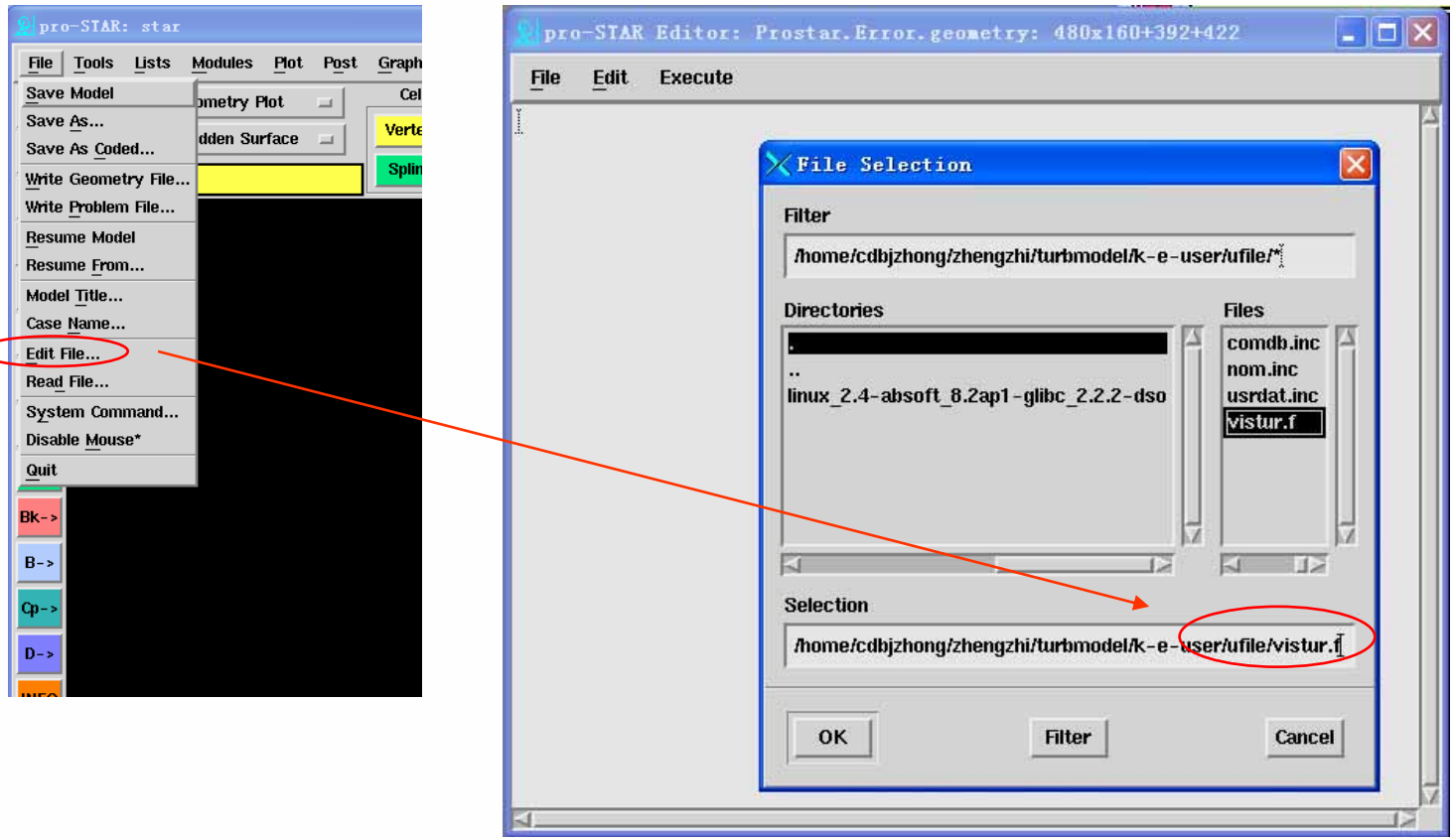
- Star-CD计算时如果要用到用户子程序，应将所有的子程序放在计算目录下的ufile文件夹中。
- 可在Prostar命令窗口中执行如下命令流生成ufile文件夹，同时会自动将子程序定义时用到的参数文件写入该文件夹：
  - syst
  - ufiles



4. 将vistur.f子程序模板写入ufile文件夹



5. 修改vistur.f子程序，添加用户模型



打开vistur.f文件，加入用户自定义程序代码段

5. 修改vistur.f子程序，添加用户模型

pro-STAR Editor: Prostar.Error.geometry: 480x160+392+422

File Edit Execute

```
C************************************************************************
      SUBROUTINE VISTUR(VIST)
C     Viscosity (turbulent)
C************************************************************************
C-----------------------------------------------------------------------*
C     STAR VERSION 3.26.000                                             *
C-----------------------------------------------------------------------*
      INCLUDE 'comdb.inc'

      COMMON/USR001/INTFLG(100)

      INCLUDE 'usrdat.inc'
      DIMENSION SCALAR(50)
      EQUIVALENCE( UDAT12(001), ICTID )
      EQUIVALENCE( UDAT03(009), DUDX )
      EQUIVALENCE( UDAT03(010), DVDX )
      EQUIVALENCE( UDAT03(011), DWDX )
      EQUIVALENCE( UDAT03(012), DUDY )
      EQUIVALENCE( UDAT03(013), DVDY )
      EQUIVALENCE( UDAT03(014), DWDY )
      EQUIVALENCE( UDAT03(015), DUDZ )
      EQUIVALENCE( UDAT03(016), DVDZ )
      EQUIVALENCE( UDAT03(017), DWDZ )
      EQUIVALENCE( UDAT03(018), SECINV )
      EQUIVALENCE( UDAT04(001), CP )
      EQUIVALENCE( UDAT04(002), DEN )
      EQUIVALENCE( UDAT04(003), ED )
      EQUIVALENCE( UDAT04(006), P )
      EQUIVALENCE( UDAT04(008), TE )
      EQUIVALENCE( UDAT04(009), SCALAR(01) )
      EQUIVALENCE( UDAT04(059), U )
      EQUIVALENCE( UDAT04(060), V )
      EQUIVALENCE( UDAT04(061), W )
      EQUIVALENCE( UDAT04(062), VISM )
      EQUIVALENCE( UDAT04(007), T )
      EQUIVALENCE( UDAT04(067), X )
      EQUIVALENCE( UDAT04(068), Y )
      EQUIVALENCE( UDAT04(069), Z )
C-----------------------------------------------------------------------
C
C    This subroutine enables the user to specify the turbulent viscosity
C    (VIST) in an arbitrary manner.
C
C    ** Parameter to be returned to STAR:  VIST
C
C-----------------------------------------------------------------------
C
C    Sample coding: To specify the turbulent viscosity for a group of
C                   cells with cell table number 2
```

vistur.f子程序提供的变量，
变量含义可查阅 ufile/nom.inc 文件

```
C    (VIST) in an arbitrary manner.
C
C    ** Parameter to be returned to STAR:  VIST
C
C-----------------------------------------------------------------------
C
C    Sample coding: To specify the turbulent viscosity for a group of
C                   cells with cell table number 2
C
C      IF(ICTID.EQ.2) VIST=0.01
C-----------------------------------------------------------------------

      Cmyu =0.09

C-- durbin
       alpha=1.0

       If(ED.eq.0) then
         ZED=1.0e-15
       else
         ZED=ED
       endif

       ZA=TE/ZED

C

C        ZS=(SECINV ** 2.0 * 0.5)**0.5

       ZS0 = (DUDX**2.0 + DVDY**2.0 + DWDZ**2.0)
       ZS1 = (DUDY+DVDX)**2.0
       ZS2 = (DUDZ+DWDX)**2.0
       ZS3 = (DVDZ+DWDY)**2.0

       ZS=( 2.0*ZS0 + ZS1 + ZS2 + ZS3 )**0.5
C
       ZB=Cmyu * 3.0**0.5 * ZS

       If(ZB.eq.0) then
         ZB=1.0e-15
       endif

       ZB=alpha / ZB

       ZT=min(ZA,ZB)

       VIST=DEN * Cmyu * TE * ZT


      RETURN
      END
C
```

添加用户自定义程序代码段，保存

范 例

算例2 湍流模型加入

添加MMK湍流模型和DURBIN1湍流模型，方程如下：

[模型介绍]

基于标准k- ε 模型的改进两方程模型MMK模型与DURBIN模型。各模型不同之处见下表：

$$S = \sqrt{\frac{1}{2}\left(U_{ij} + U_{ji}\right)^2}$$

$$\Omega = \sqrt{\frac{1}{2}\left(U_{ij} - U_{ji}\right)^2}$$

$$T = \min\left(\frac{k}{\varepsilon}, \frac{\alpha}{C_\mu S\sqrt{3}}\right)$$

	P_k	ν_t
标准k- ε	$\nu_t S^2$	$C_\mu k^2/\varepsilon$
MMK	$\nu_t S^2$	$C_\mu k^2/\varepsilon$ [Ω≥S] $C_\mu k^2/\varepsilon * (\Omega/S)$ [Ω<S]
DURBIN1	$\nu_t S^2$	$C_\mu k*T$

DURBIN1中 α =1.0。

符号说明：

P_k 湍流脉动动能K的产生项 (单位：m^2*s^{-3})

ν_t 湍流动力粘性系数 (单位：m^2*s^{-1})

S 变形速度尺度 (单位：s^{-1})

Ω 旋转速度尺度 (单位：s^{-1})

K 湍流脉动动能 (单位：m^2*s^{-2})

ε 湍流动能耗散率 (单位：m^2*s^{-3})

C_μ 常系数 C_μ=0.09

T 最小时间尺度 (单位：s)

范 例

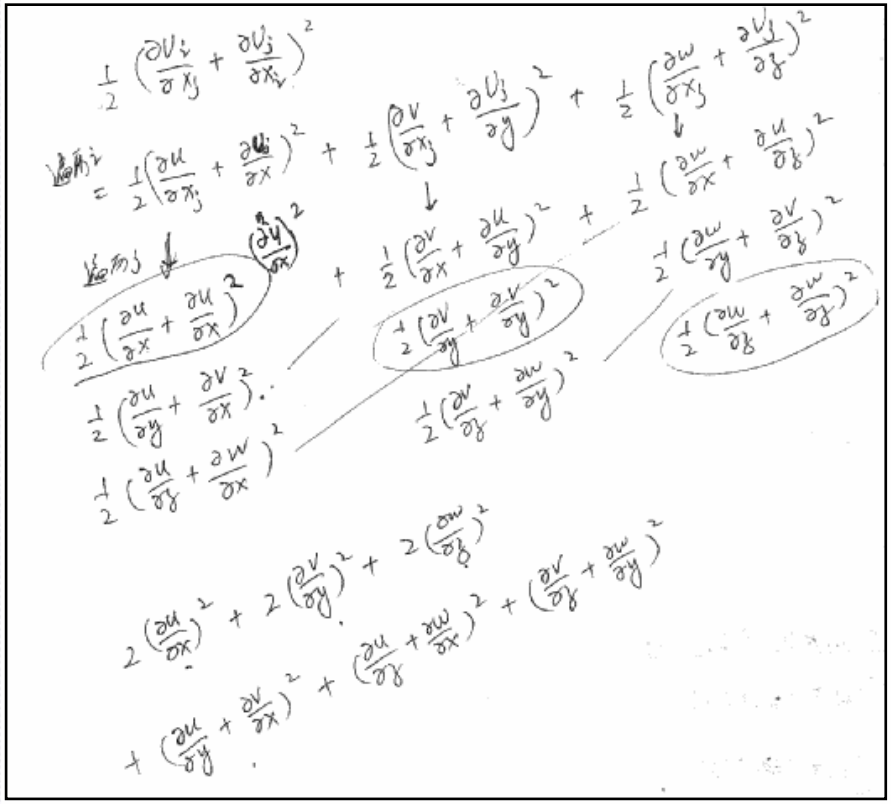
Table 1 Modeling of P_k and ν_t

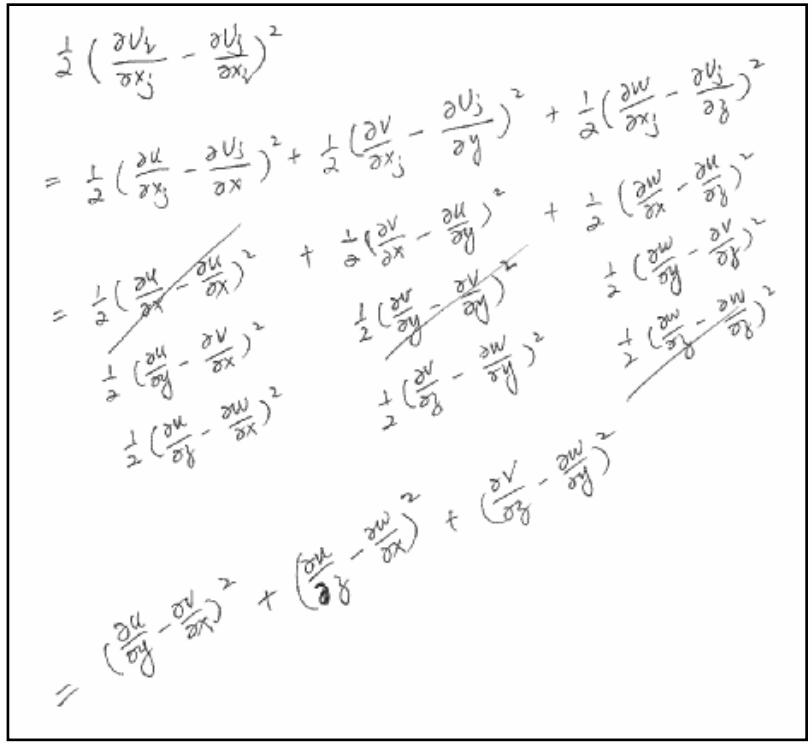
	P_k	ν_t
標準k-ε	$\nu_t S^2$ (1)	$C_\mu k^2/\varepsilon$ (7)
LK	$\nu_t S\Omega$ (2)	
改良LK	$\nu_t S^2$ [$\Omega/S \geq 1$] (3) $\nu_t S\Omega$ [$\Omega/S < 1$] (4)	
MMK	$\nu_t S^2$ (5)	$C_\mu k^2/\varepsilon$ [$\Omega/S \geq 1$] (8) $C_\mu k^2/\varepsilon \cdot \Omega/S$ [$\Omega/S < 1$] (9)
Durbin	$\nu_t S^2$ (6)	$C_\mu kT$ (10) (13) 式の α=1.0
Durbin2	$\nu_t S^2$ (6)	$C_\mu kT$ (10) (13) 式の α=0.5

$$S = \sqrt{\frac{1}{2}\left(\frac{\partial U_i}{\partial x_j} + \frac{\partial U_j}{\partial x_i}\right)^2} \quad (11),\quad \Omega = \sqrt{\frac{1}{2}\left(\frac{\partial U_i}{\partial x_j} - \frac{\partial U_j}{\partial x_i}\right)^2} \quad (12),\quad T = \min\left(\frac{k}{\varepsilon}, \frac{\alpha}{C_\mu\sqrt{3}S}\right) \quad (13)$$

durbin1

范　例 - Ω&S形式展开





Vistur.f + switch 12

```
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************
      SUBROUTINE VISTUR(VIST)
C     Viscosity (turbulent)
C***********************************************************
************
C-------------------------------------------------------------*
C     STAR VERSION 3.26.000                                   *
C-------------------------------------------------------------*
      INCLUDE 'comdb.inc'

      COMMON/USR001/INTFLG(100)

      INCLUDE 'usrdat.inc'
      DIMENSION SCALAR(50)
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      Cmyu =0.09

C-- durbin
      alpha=1.0

      If(ED.eq.0) then
        ZED=1.0e-15
      else
        ZED=ED
      endif

      ZA=TE/ZED

C
      ZS=(SECINV ** 2.0 * 0.5)**0.5
C
      ZB=Cmyu * 3.0**0.5 * ZS

      If(ZB.eq.0) then
        ZB=1.0e-15
      endif

      ZB=alpha / ZB

      ZT=min(ZA,ZB)

      VIST=DEN * Cmyu * TE * ZT


      RETURN
      END
C
```
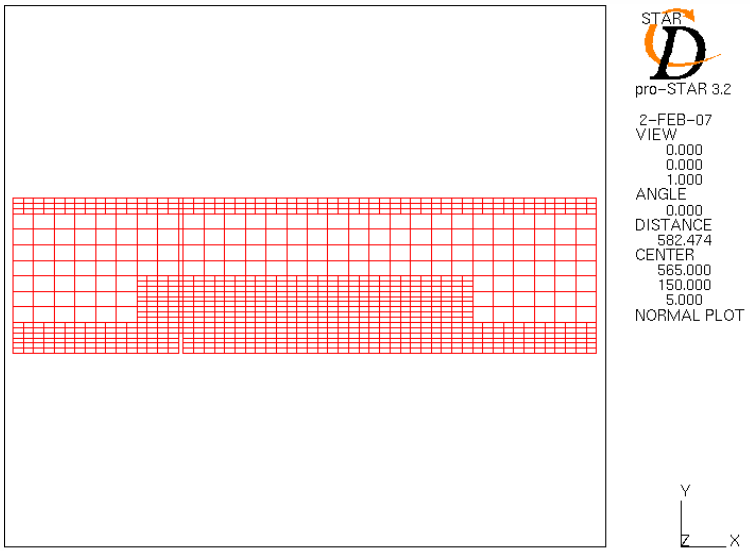
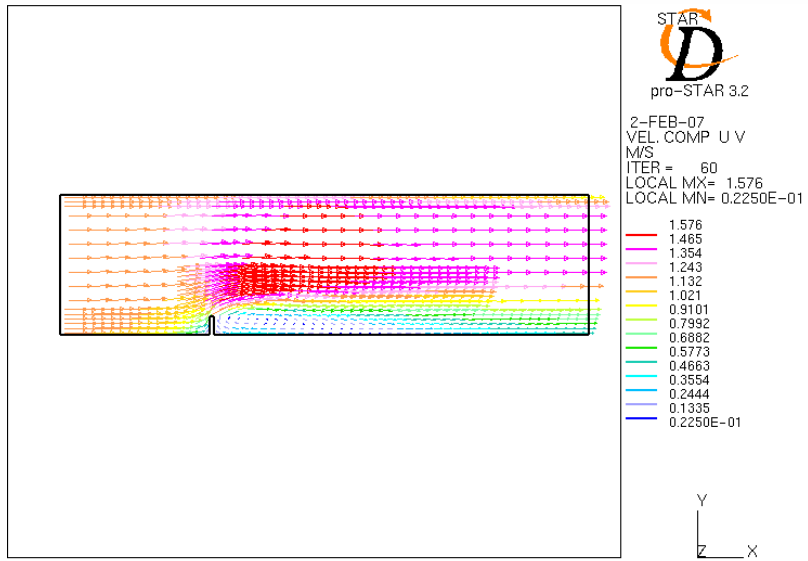

范 例

Tutorial8 Air Flow Over An Obstacle

Inlet
U = 1.17m/s
k = 0.024 m2/s2
e = 0.07 m2/s3

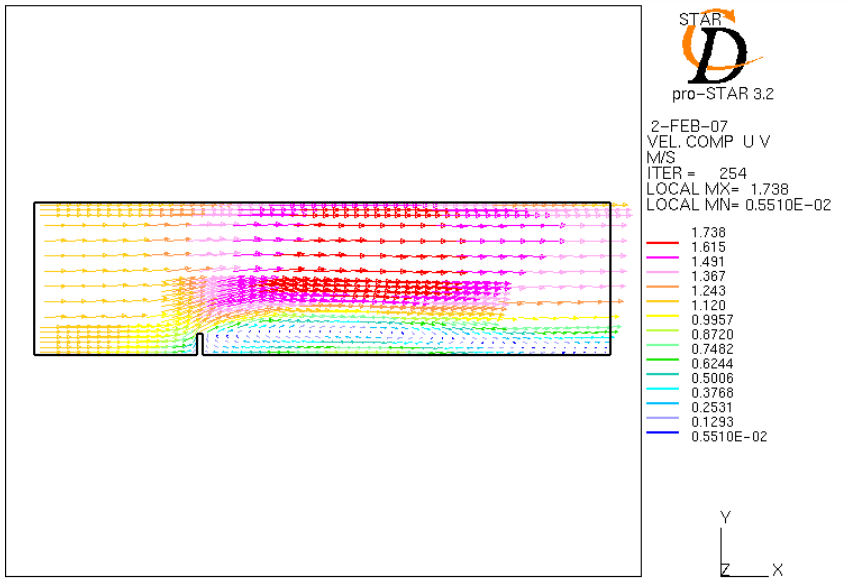
k-e model



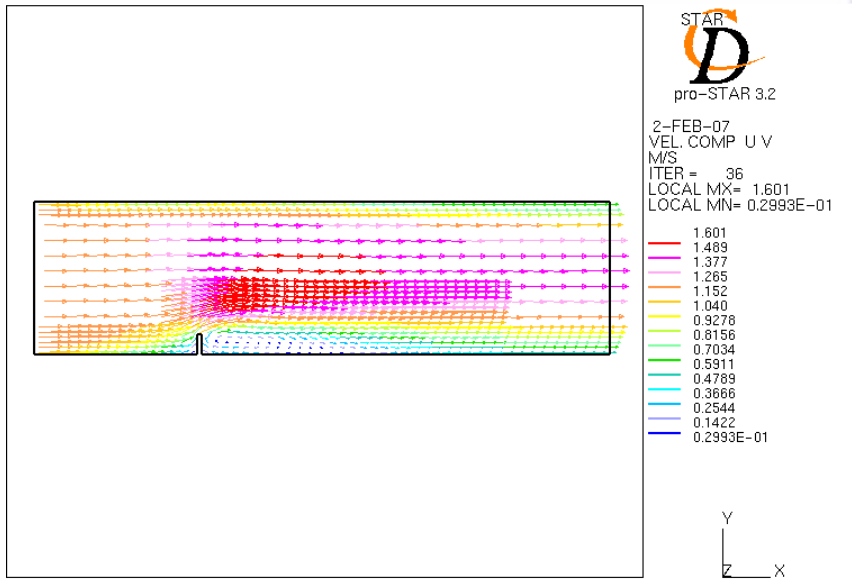


范 例

DURBIN1 model



MMK model



Thanks !