OpenFOAM勉強会 for beginner 2

- SingleDetachedHouse -
potentialFoamの組込み

2012年02月25日
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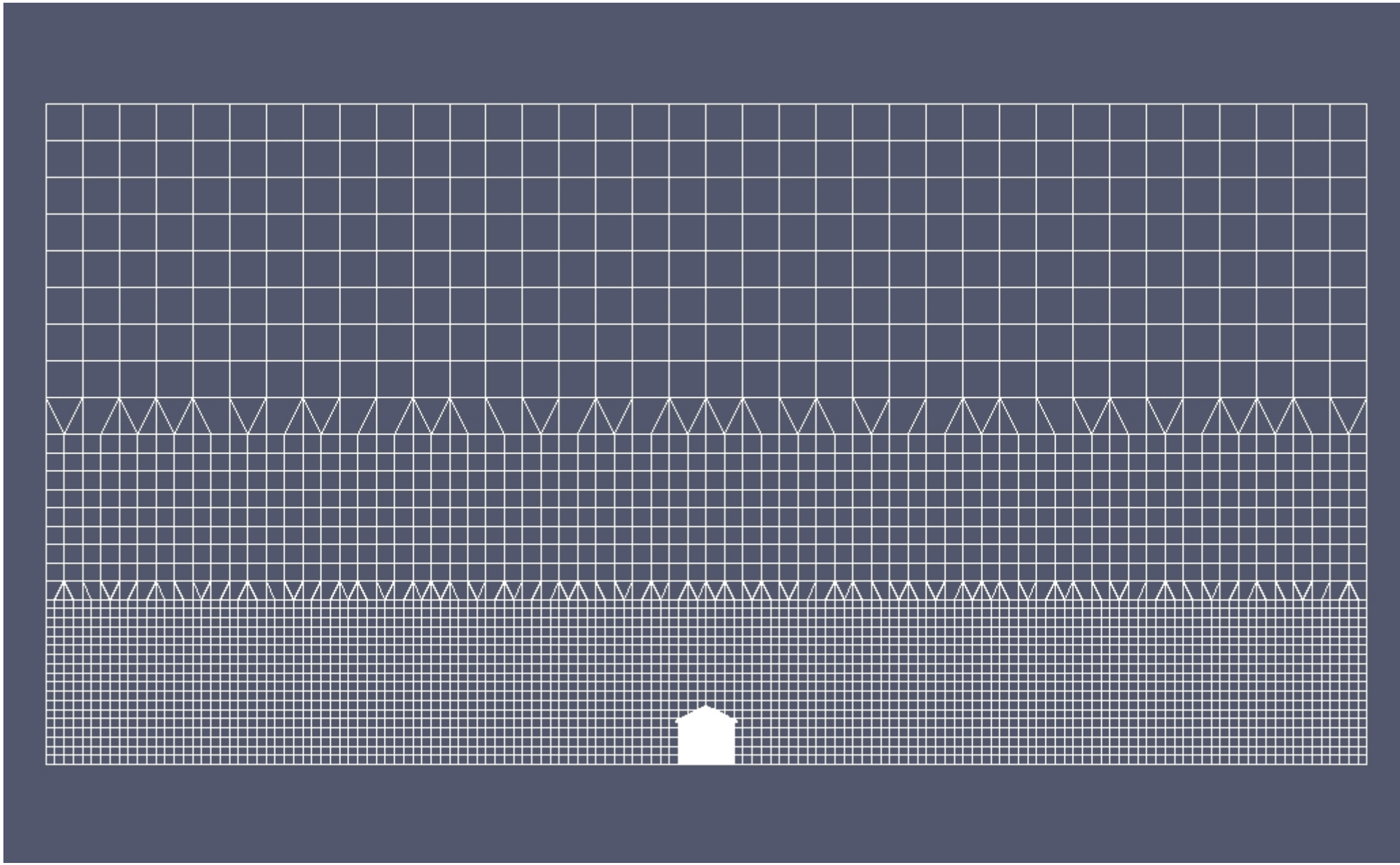
SingleDetachedHouse!

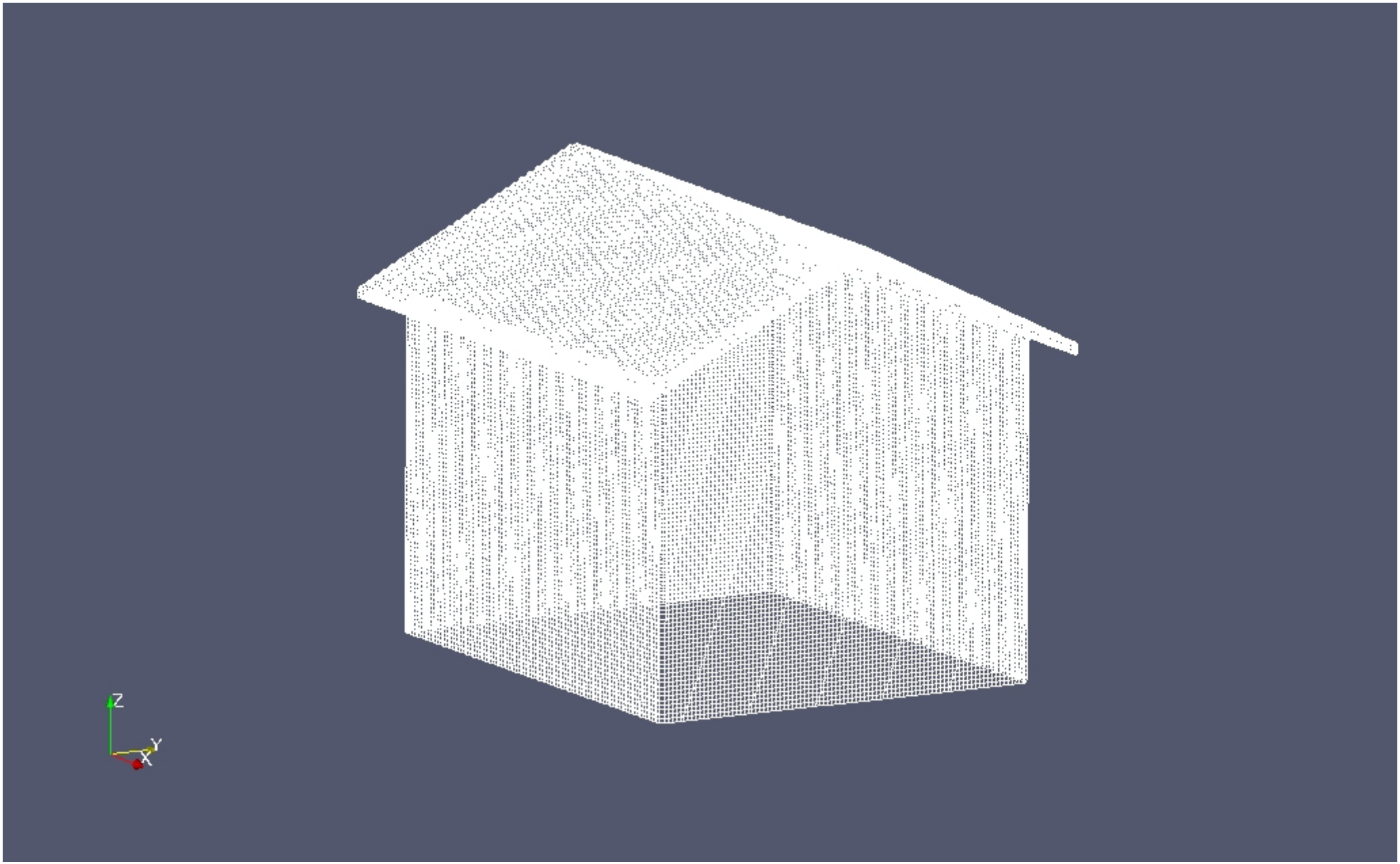
＜目的＞

- チュートリアルの＜motorBike＞のAllrunシェル内にあるように、「potentialFoam」機能を付け加える。
- 初期値を付加することにより、解析時間がどの程度短くなるかを確かめる。

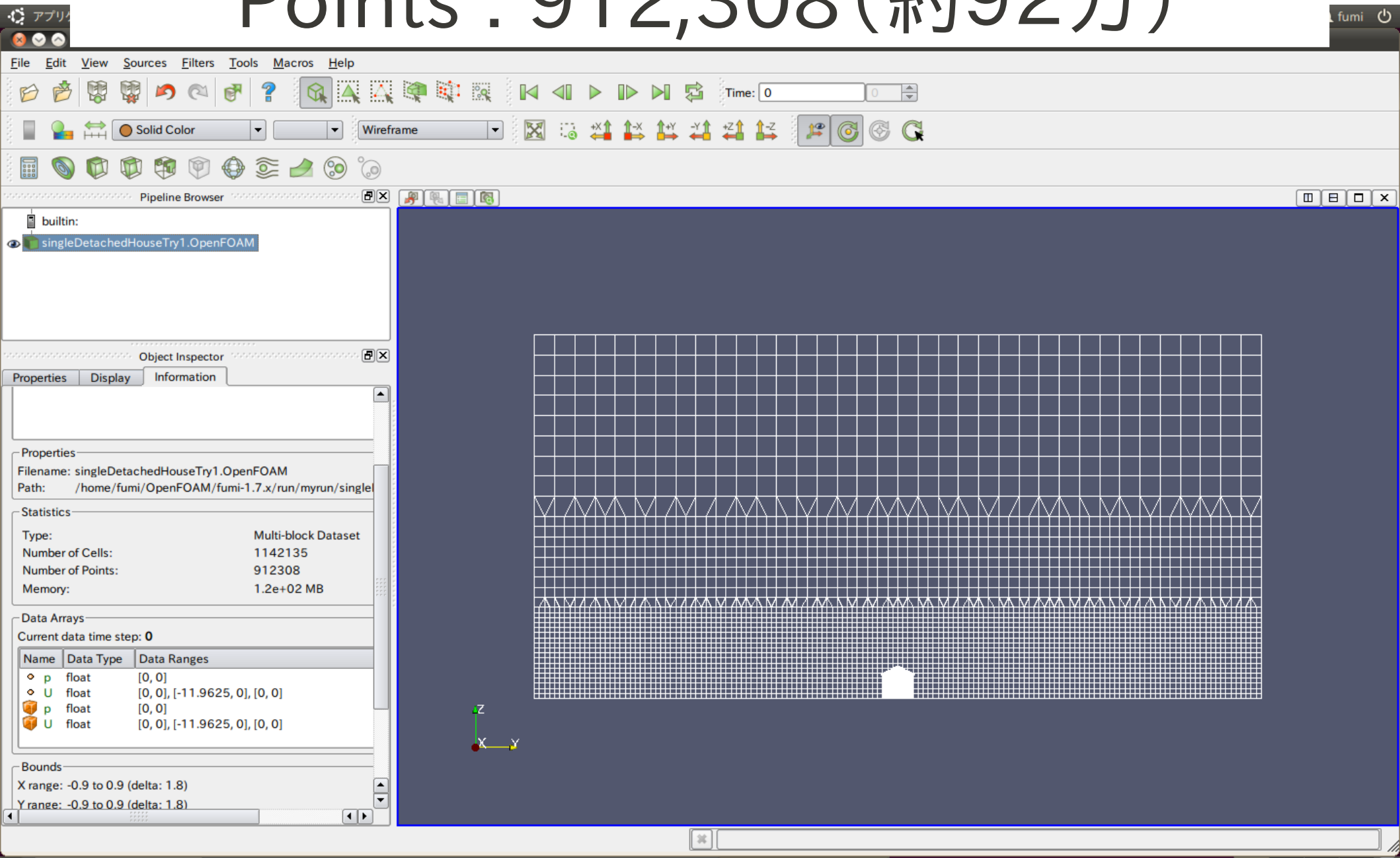
Model



House model

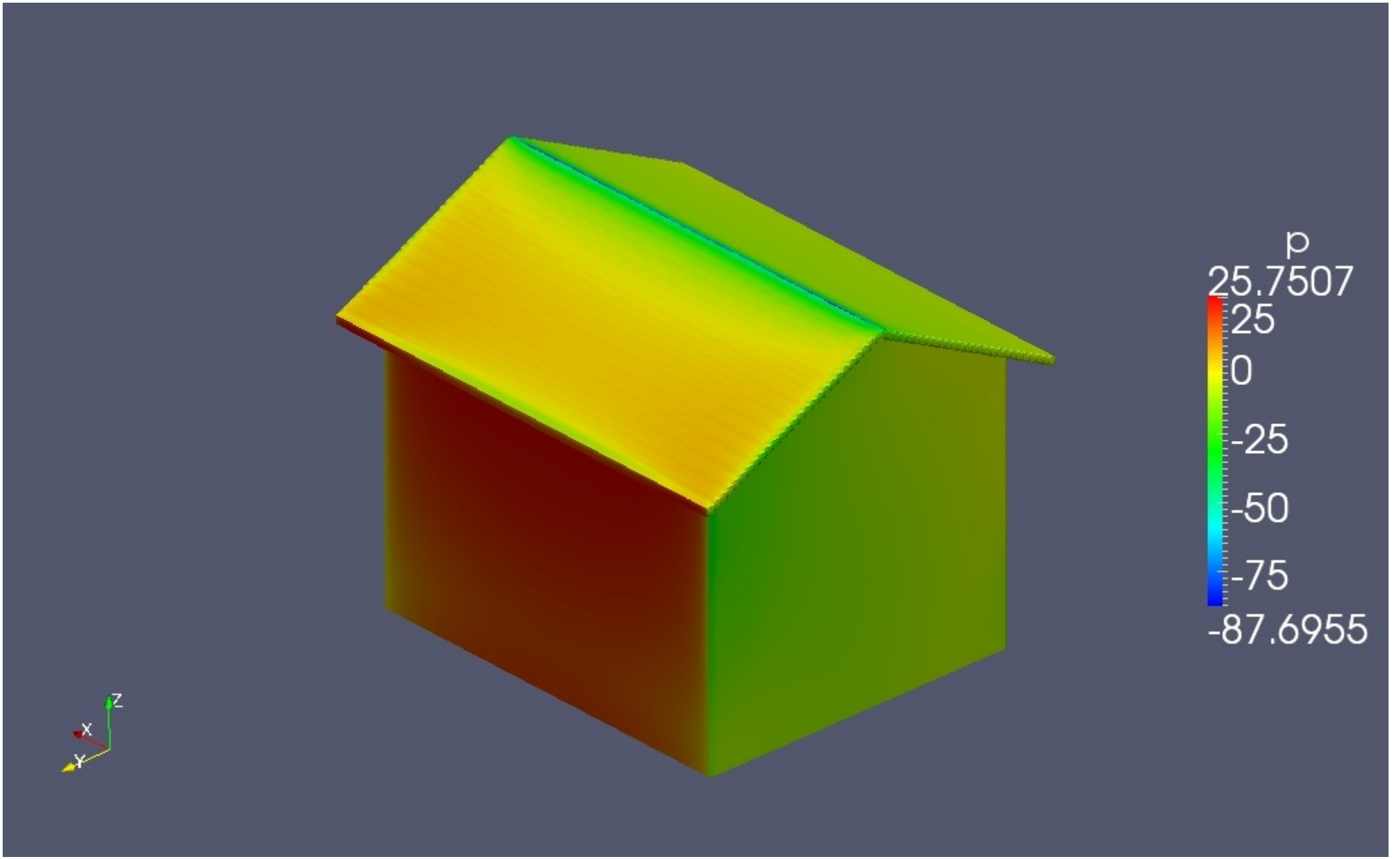


Cells : 1142,135(約114万)
Points : 912,308（約92万）



圧力結果　kgf/m2

注）密度を掛ける必要あり



解析の流れ

1.初期化
2.格子生成
3.計算初期条件設定
4. PotentialFoam実行
5.計算実行
  5.A)非並列計算、の場合
  5.B)並列計算、の場合
    5.B.1)領域分割
    5.B.2)計算実行
    5.B.3)領域統合
6.結果プロット

1. make clean
2. make mesh
3. make init
4. PotentialFoam実行
5.
  5.A) make fgrun (フォアグランド)
    make bgrun (バックグラウンド)
  5.B.1）make de
  5.B.2) make pfgrun (フォアグランド)
    make pbgrun (バックグランド)
  5.B.3) make re
6. make plot

起動シェル　myAllrun3

```
#!/bin/sh
# <myAllrun3>
#------------------------------------------------------------------
#                    SingleDetachedHouse
#------------------------------------------------------------------
CORE=4   # e.g. 1,4,6,12,...
RUN=1    # 1:Foreground, 2:Background

#------- from Allrun of motorBike --------
. $WM_PROJECT_DIR/bin/tools/RunFunctions
#-------------------------------------

echo "-------------------------"
echo "    SingleDetachedHouse"
echo "-------------------------"
echo "CORE: ${CORE}"
echo "RUN : ${RUN} (1:Foreground, 2:Background)"

echo ">"
echo "*** PRE START"
echo "* make clean"; make clean
echo "* make mesh" ; make mesh
echo "* make init" ; make init
echo "*** PRE END"
echo ">"
```

```
#---------------------- potentialFoam ----------------------------
sed -i 's/¥(nNonOrthogonalCorrectors¥).*;/¥1 10;/g' system/fvSolution
runApplication potentialFoam -writep
sed -i 's/¥(nNonOrthogonalCorrectors¥).*;/¥1 0;/g' system/fvSolutio
#-----------------------------------------------------------------
```

追加

```
echo "*** CALC START"
if [ ${CORE} = 1 ];then
   echo "*** Single core"
   if [ ${RUN} = 1 ];then
      echo "* make fgrun: Foreground"; make fgrun
   else
      echo "* make bgrun: Background"; make bgrun
   fi
else
   echo "*** Multiple cores: ${CORE}"
   if [ ${RUN} = 1 ];then
      echo "* make de"     ; make de
      echo "* make pfgrun" ; make pfgrun
      echo "* make re"     ; make re
   else
      echo "* make de"     ; make de
      echo "* Please run <make re> after the background job"
      echo "* make pbgrun" ; make pbgrun
   fi
fi
echo "*** CALC END"
```

system/fvSolutionファイルの確認

```
#---------------------- potentialFoam ----------------------------
sed -i 's/¥(nNonOrthogonalCorrectors¥).*;/¥1 10;/g' system/fvSolution
runApplication potentialFoam -writep
sed -i 's/¥(nNonOrthogonalCorrectors¥).*;/¥1 0;/g' system/fvSolutio
#-----------------------------------------------------------------
```

sedコマンドの復習

```
sed -i 's/¥(nNonOrthogonalCorrectors¥).*;/¥1 10;/g' system/fvSolution
```

- diff 実行前ファイル　実行後ファイル

  63c63の比較より、

  ```
  <     nNonOrthogonalCorrectors 0;     前
  ---
  >     nNonOrthogonalCorrectors 10;    後
  ```

sedコマンドの復習
system/FvSolution ファイル
(sed実行後=potentialFoam実行前)

fumi@fumi-desktop: ~/OpenFOAM/fumi-1.7.x/run/tutorials/incompressible/simpleFoam/motorBikeRun5sed/system

ファイル(F) 編集(E) 表示(V) 端末(T) ヘルプ(H)

```
    {
        solver          smoothSolver;
        smoother        GaussSeidel;
        tolerance       1e-8;
        relTol          0.1;
        nSweeps         1;
    };
}

SIMPLE
{
    nNonOrthogonalCorrectors 10;
}

relaxationFactors
{
    p               0.3;
    U               0.7;
    k               0.7;
    omega           0.7;
}

// ************************************************************************* //
```

potentialFoam実行するとエラー発生

log.potentialFoam (~/myrunへのリンク/singleDetachedHouse/singleDetachedHouse2potentialFoamTest1) - gedit

ファイル(F) 編集(E) 表示(V) 検索(S) ツール(T) ドキュメント(D) ヘルプ(H)

log.potentialFoam

```
}

Reading field p

Reading field U


Calculating potential flow


--> FOAM FATAL IO ERROR:
keyword laplacian(1,p) is undefined in dictionary "/opt/OpenFOAM/fumi-1.7.x/run/myrun/
singleDetachedHouse/singleDetachedHouse2potentialFoamTest1/system/
fvSchemes::laplacianSchemes"

file: /opt/OpenFOAM/fumi-1.7.x/run/myrun/singleDetachedHouse/
singleDetachedHouse2potentialFoamTest1/system/fvSchemes::laplacianSchemes from line 43
to line 49.

    From function dictionary::lookupEntry(const word&, bool, bool) const
    in file db/dictionary/dictionary.C at line 395.

FOAM exiting
```

laplacian(1,p)を追加（修正）

system/fvSchemesファイルの編集

```
divSchemes
{
    default          none;
    div(phi,U)      Gauss vanLeerV;
    div(phi,k)      Gauss vanLeer;
    div(phi,epsilon) Gauss vanLeer;
    div(phi,R)      Gauss vanLeer;
    div(R)          Gauss linear;
    div(phi,nuTilda) Gauss vanLeer;
    div((nuEff*dev(grad(U).T()))) Gauss linear;
}

laplacianSchemes
{
    default          none;
    laplacian(nuEff,U) Gauss linear corrected;
    laplacian((1|A(U)),p) Gauss linear corrected;
    laplacian(1,p) Gauss linear corrected;
    laplacian(DkEff,k) Gauss linear corrected;
    laplacian(DepsilonEff,epsilon) Gauss linear corrected;
    laplacian(DREff,R) Gauss linear corrected;
    laplacian(DnuTildaEff,nuTilda) Gauss linear corrected;
}

interpolationSchemes
```

potentialFoam、今度は成功

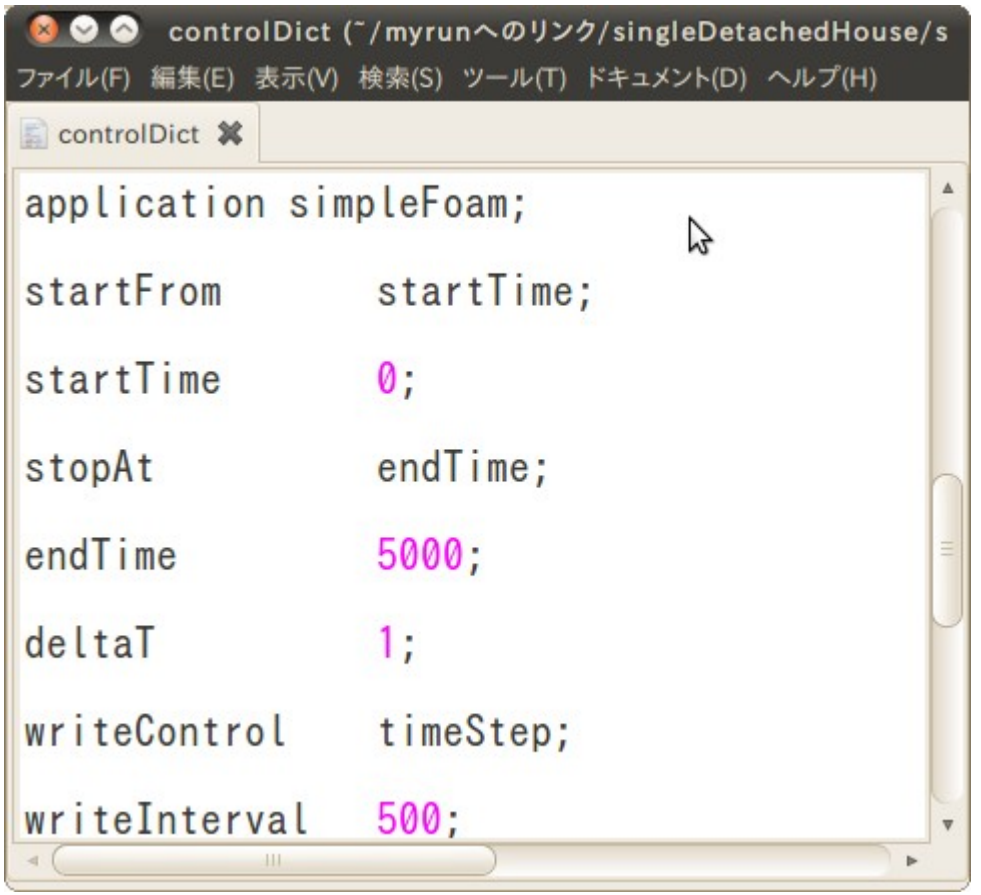
```
Calculating potential flow
GAMG:  Solving for p, Initial residual = 1, Final residual = 0.0083456, No Iterations 8
GAMG:  Solving for p, Initial residual = 0.00939914, Final residual = 7.80584e-05, No Iterations 2
GAMG:  Solving for p, Initial residual = 0.000143049, Final residual = 1.08047e-06, No Iterations 6
GAMG:  Solving for p, Initial residual = 1.59672e-05, Final residual = 6.70594e-07, No Iterations 1
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
GAMG:  Solving for p, Initial residual = 7.91639e-07, Final residual = 7.91639e-07, No Iterations 0
continuity error = 0.000625809
Interpolated U error = 1.55992e-05
ExecutionTime = 17.58 s  ClockTime = 17 s

End
```

SimpleFoamの実行

MyAllrun3の実行

- 4 Cores で実行
- 反復回数は5000回
(System/controlDict)

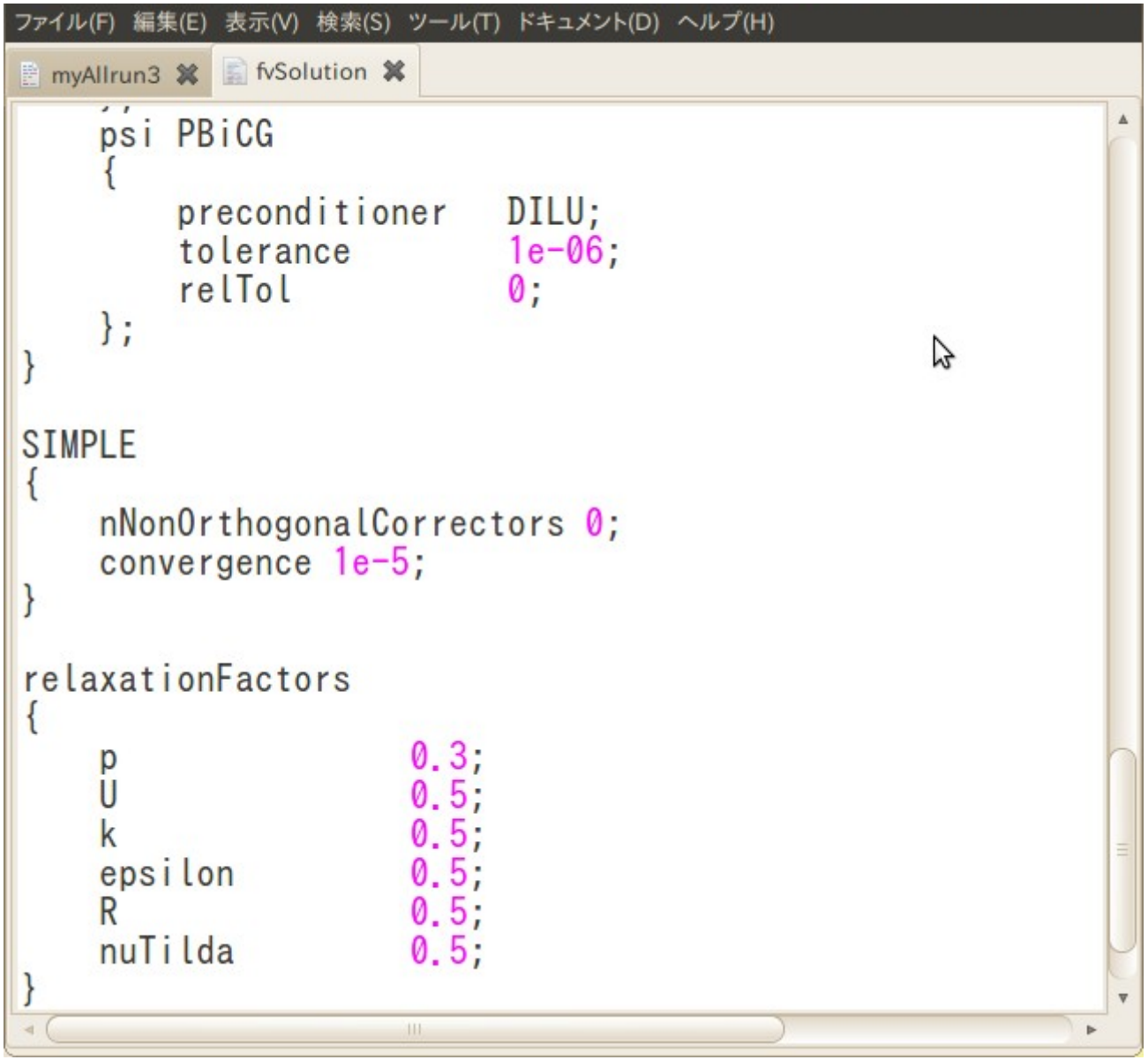


SIMPLE 法の収束判定の設定 system/fvSolution ファイル

```
SIMPLE
{
    nNonOrthogonalCorrectors 0;
    convergence 1e-5;
}
```

- simpleFoam では、U と p のすべての残差が指定された値（1e-5 or 0.00001)より小さくなった時点で結果が保存され計算が停止する。

system/fvSolutionファイルの確認



system/fvSolutionファイルの確認

- FvSolutionファイルの中には
  nNonOrthogonalCorrectors 0
  が存在する。
- 但し、「convergence 1e-5;」も存在する。この影響がどうなるのか？　確認が必要である。

PotentialFoam無　3.4時間

log.simpleFoam (~/myrunへのリンク/singleDetachedHouse/singleDetachedHouseMyAllrun2) - gedit

ファイル(F) 編集(E) 表示(V) 検索(S) ツール(T) ドキュメント(D) ヘルプ(H)

log.simpleFoam

```
Time = 5000

DILUPBiCG:  Solving for Ux, Initial residual = 2.77008e-05, Final residual = 1.34025e-06, No Iterations 1
DILUPBiCG:  Solving for Uy, Initial residual = 3.42957e-07, Final residual = 3.42957e-07, No Iterations 0
DILUPBiCG:  Solving for Uz, Initial residual = 9.21495e-06, Final residual = 9.21495e-06, No Iterations 0
GAMG:  Solving for p, Initial residual = 0.00140228, Final residual = 8.34004e-06, No Iterations 2
time step continuity errors : sum local = 1.33092e-06, global = 8.46353e-09, cumulative = 0.213431
DILUPBiCG:  Solving for epsilon, Initial residual = 9.76029e-06, Final residual = 9.76029e-06, No Iterations 0
DILUPBiCG:  Solving for k, Initial residual = 6.51391e-06, Final residual = 6.51391e-06, No Iterations 0
ExecutionTime = 11798.5 s  ClockTime = 12241 s

End

Finalising parallel run
```

PotentialFoam有　3.2時間

log.simpleFoam (~/myrunへのリンク/singleDetachedHouse/singleDetachedHouse2potentialFoamTest1) - gedit

ファイル(F) 編集(E) 表示(V) 検索(S) ツール(T) ドキュメント(D) ヘルプ(H)

log.simpleFoam

```
Time = 5000

DILUPBiCG:  Solving for Ux, Initial residual = 2.72799e-05, Final residual = 1.28702e-06, No Iterations 1
DILUPBiCG:  Solving for Uy, Initial residual = 3.48086e-07, Final residual = 3.48086e-07, No Iterations 0
DILUPBiCG:  Solving for Uz, Initial residual = 8.59794e-06, Final residual = 8.59794e-06, No Iterations 0
GAMG:  Solving for p, Initial residual = 0.00126332, Final residual = 8.02075e-06, No Iterations 2
time step continuity errors : sum local = 1.26232e-06, global = -1.18338e-08, cumulative = -8.22938e-05
DILUPBiCG:  Solving for epsilon, Initial residual = 8.64947e-06, Final residual = 8.64947e-06, No Iterations 0
DILUPBiCG:  Solving for k, Initial residual = 7.44353e-06, Final residual = 7.44353e-06, No Iterations 0
ExecutionTime = 11419.5 s  ClockTime = 11582 s

End

Finalising parallel run
```

解析時間の比較

PotentialFoam実行無：　3.4時間

PotentialFoam実行有：　3.2時間　（12分短縮）

＜結論＞

時短に関して、

このケースでは、あまり効果はなかった。

END