# OpenFOAM OpenFOAM勉強会 for beginner

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(*)本報告ではVer.2.0.0を使っています

# 本日のお題：functions

controlDictの最後に“Functions”の項目が付く場合がある

右の例では、“outlet”面における
圧力、流束、流速
の面積平均値を算出

```
functions
{
   faceObj1
   {
      type           faceSource;
      functionObjectLibs  ("libfieldFunctionObjects.so");
      enabled          true;
      outputControl    outputTime;
      log              true;
      valueOutput      true;
      source           patch;
      sourceName       outlet;
      operation        areaAverage;
      fields
      (
         p
         phi
         U
      );
   }
}
```

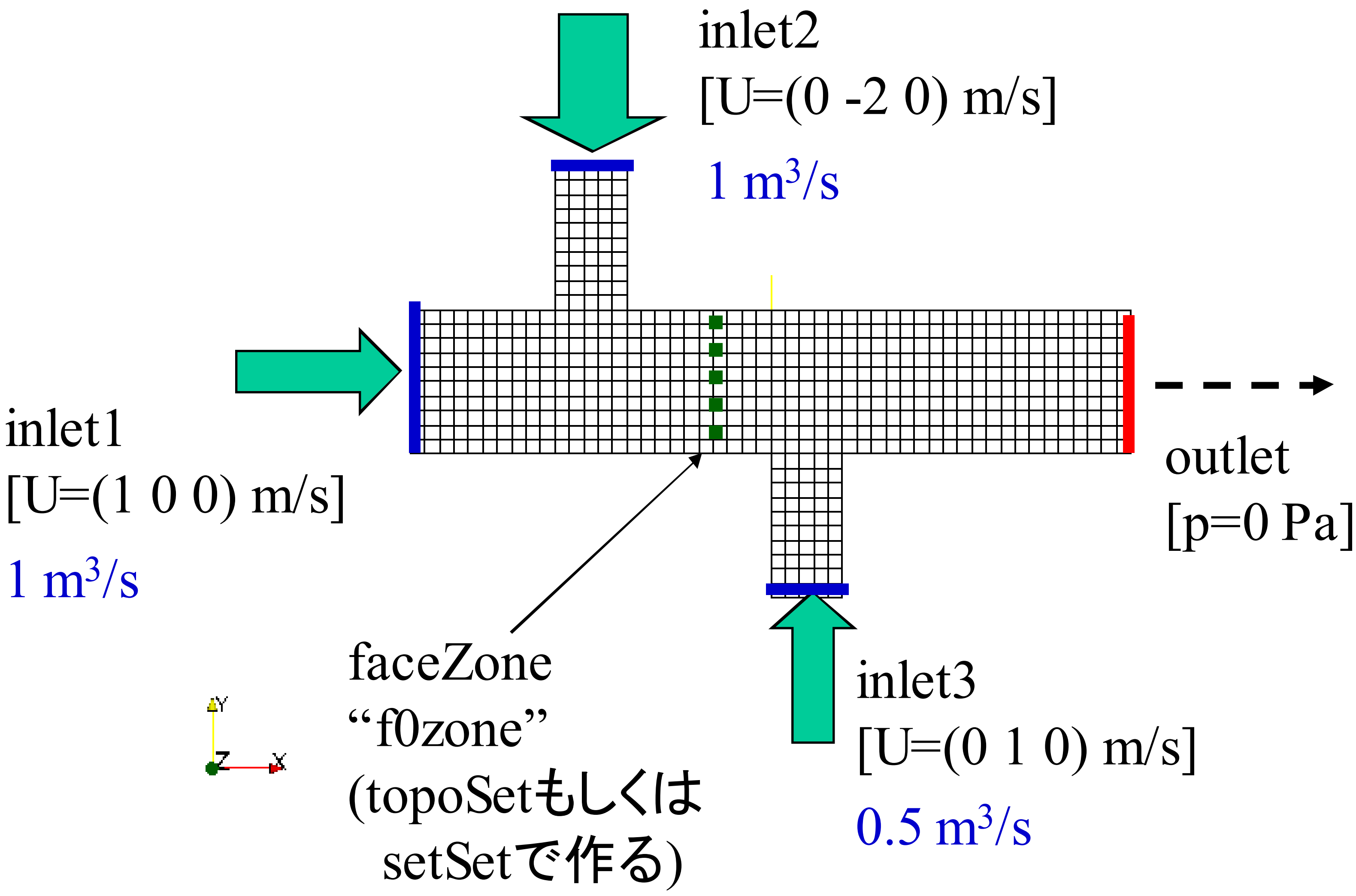
# functionsの使い方

使い方は2通り

（1）そのままソルバー計算実行
計算しながら演算値(たとえば出口の平均流速など)を
出力する

（2）ユーティリティ“execFlowFunctionObjects”を実行
計算終了後のデータ(“0”,“100”,“200”,...)に対して
演算値を計算して出力

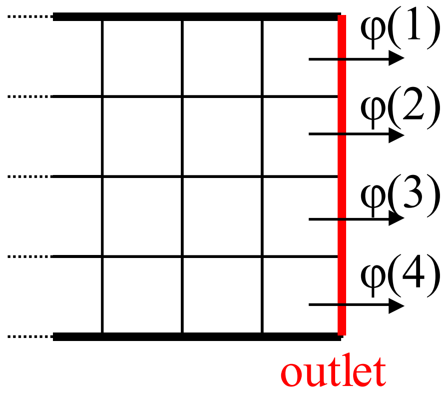
# 例題:2次元混合管


inlet2
[U=(0 -2 0) m/s]
1 m³/s
inlet1
[U=(1 0 0) m/s]
1 m³/s
outlet
[p=0 Pa]
faceZone
“f0zone”
(topoSetもしくは
setSetで作る)
inlet3
[U=(0 1 0) m/s]
0.5 m³/s
Y
Z
X

# 例題：controlDictの記述

```
・・・
・・・
functions
{
   faceObj1
   {
      type              faceSource;          //faceに対する演算
      functionObjectLibs ("libfieldFunctionObjects.so");
      enabled          true;
      outputControl   timeStep;  //timestepごとに出力
      log              true;
      valueOutput     false;
      source           patch;
      sourceName      outlet;     //outletパッチ
      operation        sum;         //総和
      fields
      (
         phi       //フェイスを通る流量[m³/s]
      );
   }
}
```

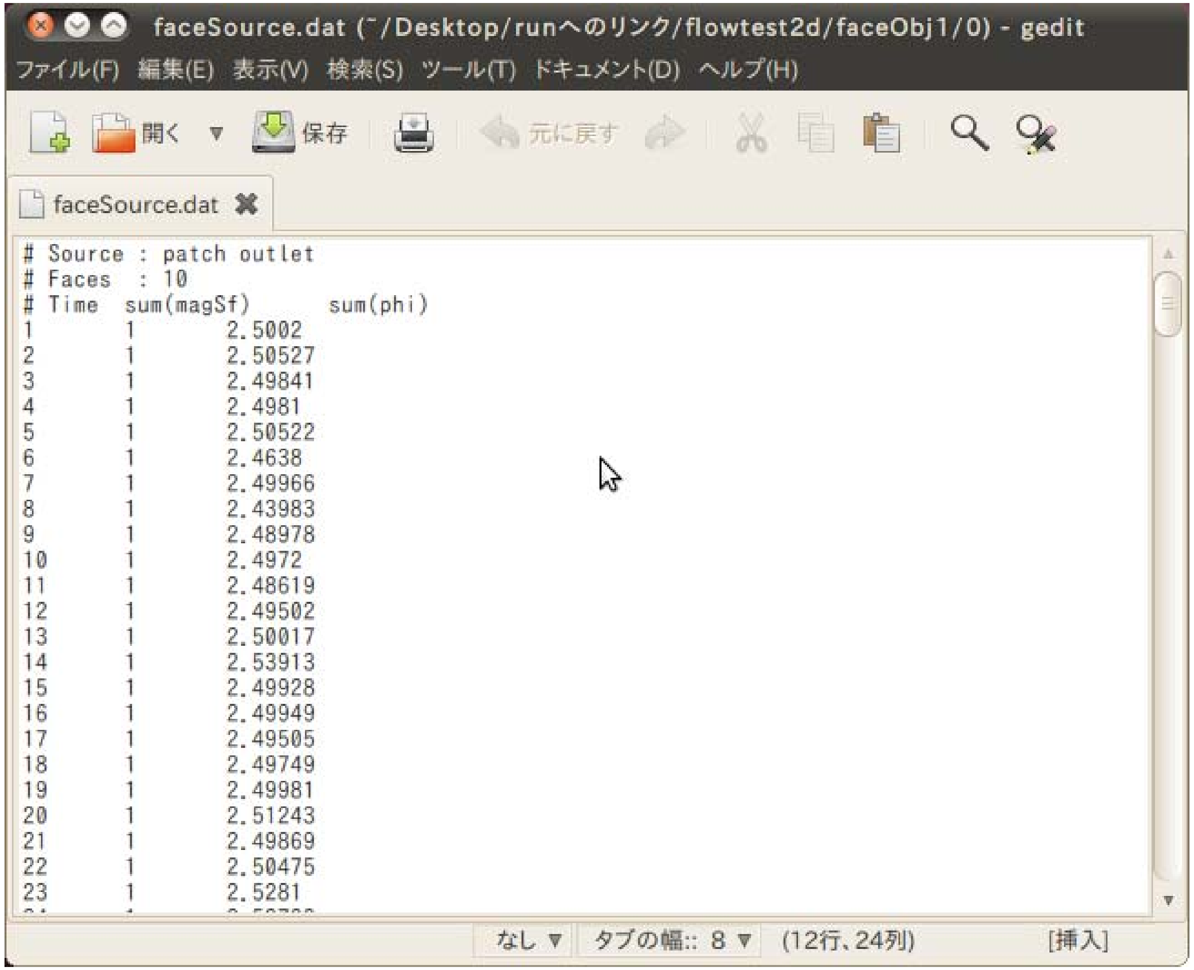
$$\phi(i) = \mathbf{U}_f(i) \cdot d\mathbf{S}(i)$$



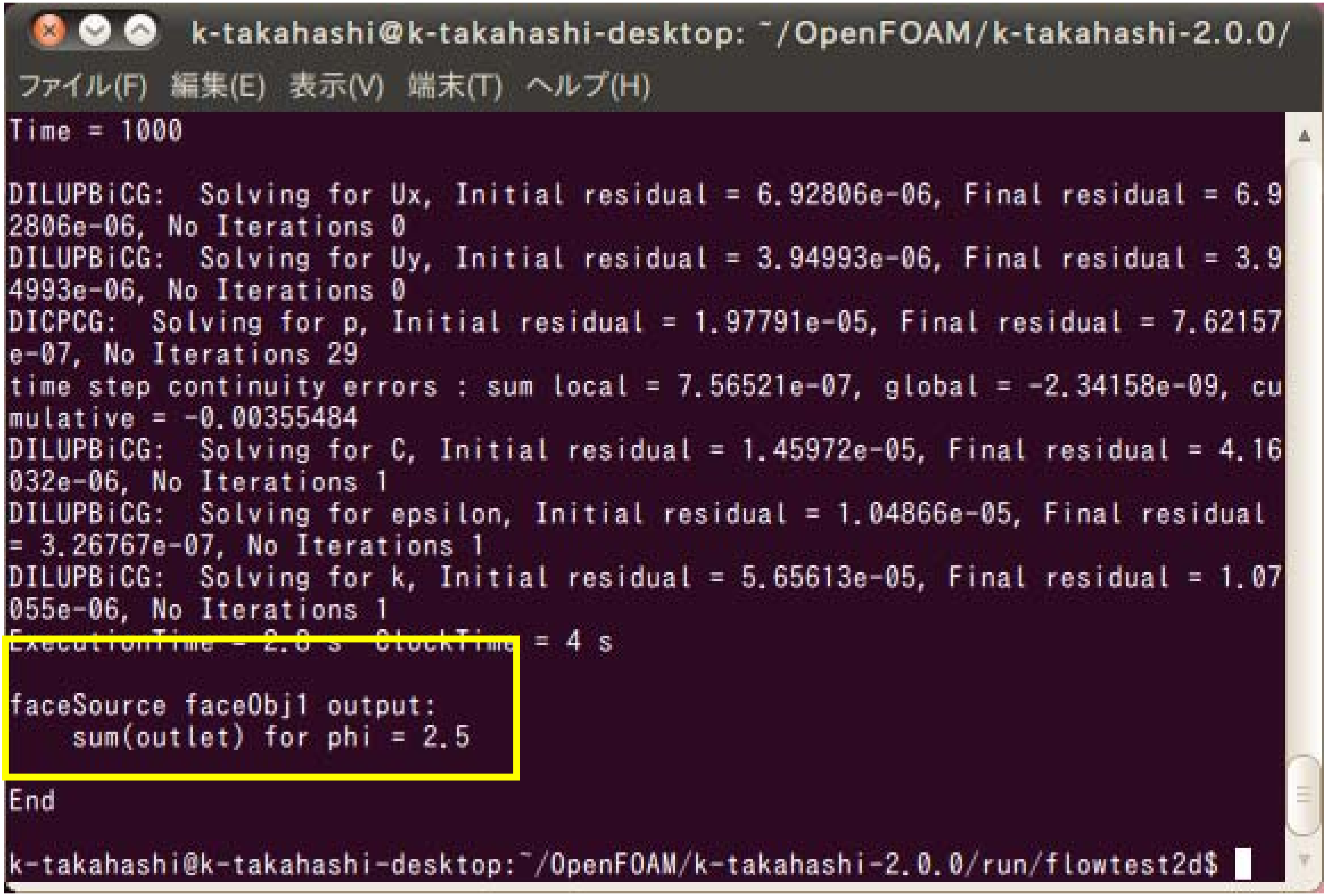

Sum(phi)
=phi(1)+ phi(2)+ phi(3)+ phi(4)
=outletを通る流量[$m^3/s$]

# 例題:出力1　ログ

faceObj1(controlDictに書いた名前)のディレクトリができる中の“faceSource.dat”ファイルに演算値が出力される

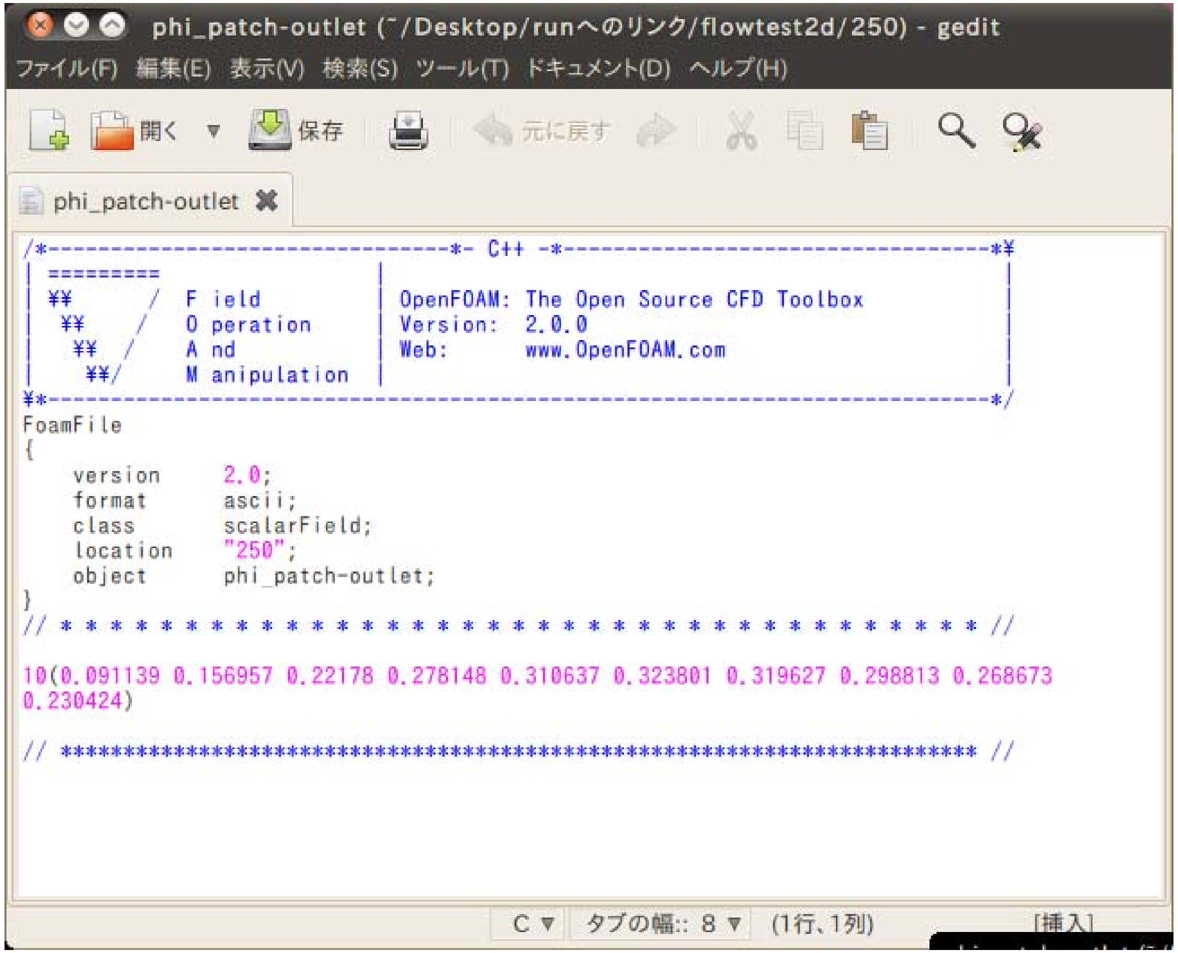


# 例題:出力2　ログ




logをtrueにすると、terminalに演算値が表示される

# 例題:出力3　データディレクトリ

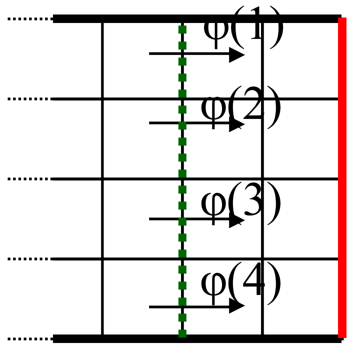



```
/*---------------------------------*- C++ -*----------------------------------*¥
| =========                 |                                                 |
| ¥¥      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  ¥¥    /   O peration     | Version:  2.0.0                                 |
|   ¥¥  /    A nd           | Web:      www.OpenFOAM.com                      |
|    ¥¥/     M anipulation  |                                                 |
¥*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       scalarField;
    location    "250";
    object      phi_patch-outlet;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

10(0.091139 0.156957 0.22178 0.278148 0.310637 0.323801 0.319627 0.298813 0.268673
0.230424)

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

valueOutputをtrueにすると、各時刻のデータディレクトリ
(“0”,“100”,“200”,...)内に演算値が格納される
この例では、“phi_patch-outlet”

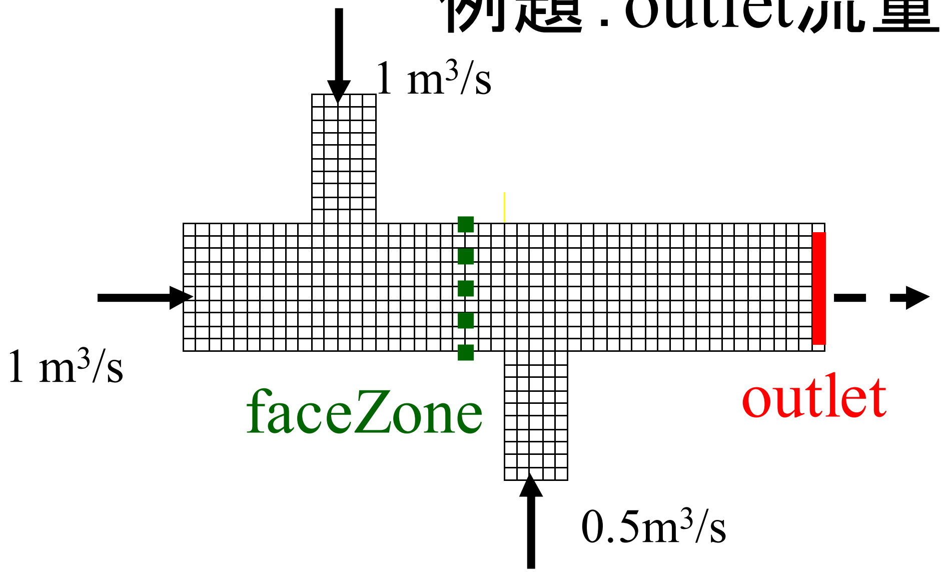
# 例題：contolDictの記述　その2

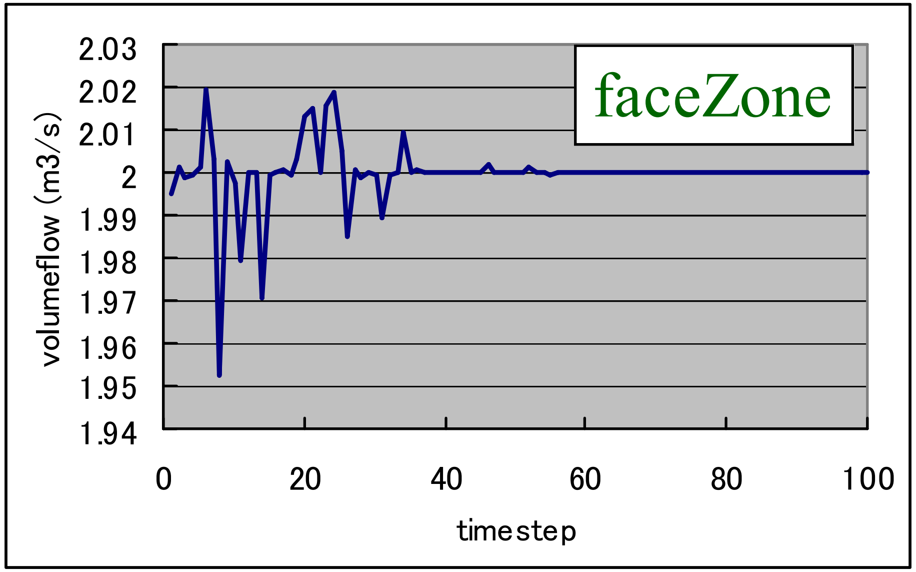
```
・・・
・・・
functions
{
    faceObj2
    {
        type            faceSource;
        functionObjectLibs ("libfieldFunctionObjects.so");
        enabled         true;
        outputControl   timeStep;
        log             true;
        valueOutput     false;
        source          faceZone;
        sourceName      f0zone;    //zone名
        operation       sum;       //総和
        fields
        (
            phi     //フェイスゾーンを通る流量[m3/s]
        );
    }
}
```

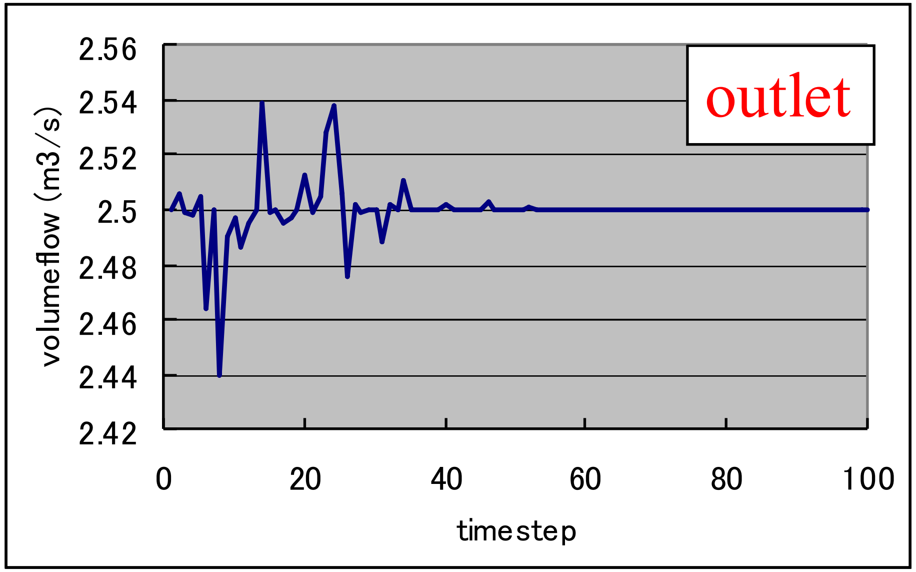



fazeZoneを使えばpatch(境界)だけではなく内部faceでも可

# 例題：outlet流量の推移




40stepくらいで流量が収束（マスバランスの確認）

# もっと詳しくfunctionsを知るために（type）

```
functions
{
   faceObj1
   {
      type            faceSource1;  //わざと間違えてみる
      functionObjectLibs ("libfieldFunctionObjects.so");
      enabled         true;
      outputControl   outputTime;
      log             true;
      valueOutput     true;
      source          patch;
      sourceName      outlet;
      operation       areaAverage;
      fields
      (
       phi
      );
   }
}
```

# もっと詳しくfunctionsを知るために(type)

```
Valid  functions are :
12
(
cellSource                    //cellの最大最小・平均・総和演算
faceSource                    //faceの最大最小・平均・総和演算
fieldAverage                  //Field値(U,pなど)の時間平均
fieldMinMax                   //Field値(U,pなど)の最大・最小値
nearWallFields                //例題なし
patchProbes                   //例題なし
probes                        //指定点のField値
readFields                    //例題あり・未調査
sets                          //例題なし
streamLine                    //指定点から流線を出力
surfaceInterpolateFields      //例題なし
surfaces                      //任意の面で演算?(難しそう)
)
```

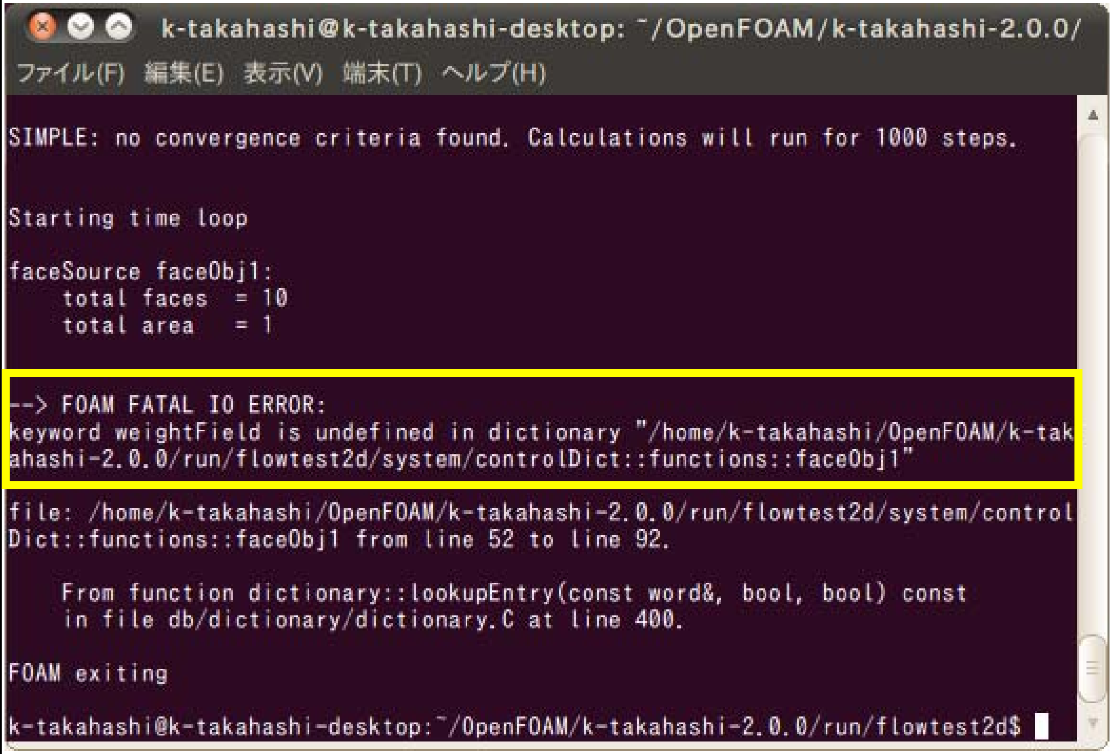
# もっと詳しくfunctionsを知るために（operation）

```
functions
{
   faceObj1
   {
      ・・・
      ・・・
      source        patch;
      sourceName    outlet;
      operation     summ;
                    //わざと間違えてみる
      fields
      (
       phi
      );
   }
}
```

```
summ is not in enumeration:
7
(
areaAverage    //面平均
areaIntegrate  //面積分
max            //最大値
min            //最小値
none           //？
sum            //総和
weightedAverage
               //重みつき平均

)
```

# もっと詳しくfunctionsを知るために（operation）

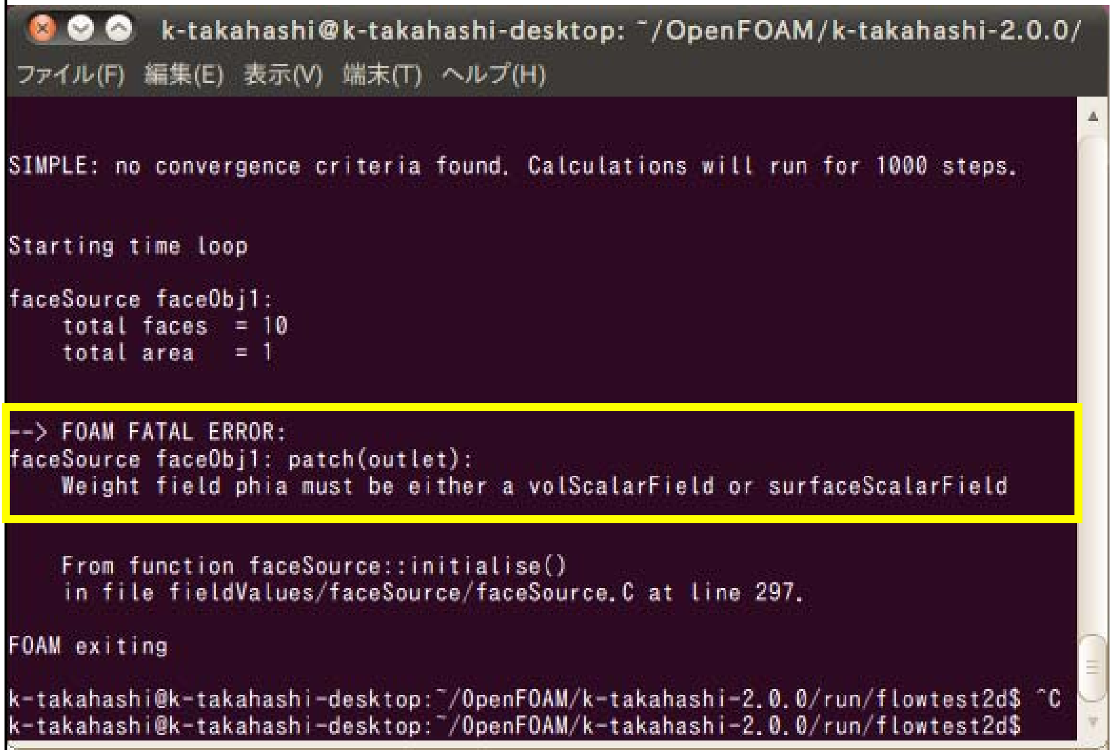
```
functions
{
  faceObj1
  {
    ・・・
    ・・・
    sourceName     outlet;
    operation  weightedAverage;
    fields
    (
     U
    );
  }
}
```




weightedAverageを使うとエラーが出る
“keyword weightField is undefined ...”

# もっと詳しくfunctionsを知るために（operation）

```
functions
{
  faceObj1
  {
    ・・・
    ・・・
    sourceName      outlet;
    operation  weightedAverage;
    weightField  aa; //適当に
    fields
    (
     U
    );
  }
}
```

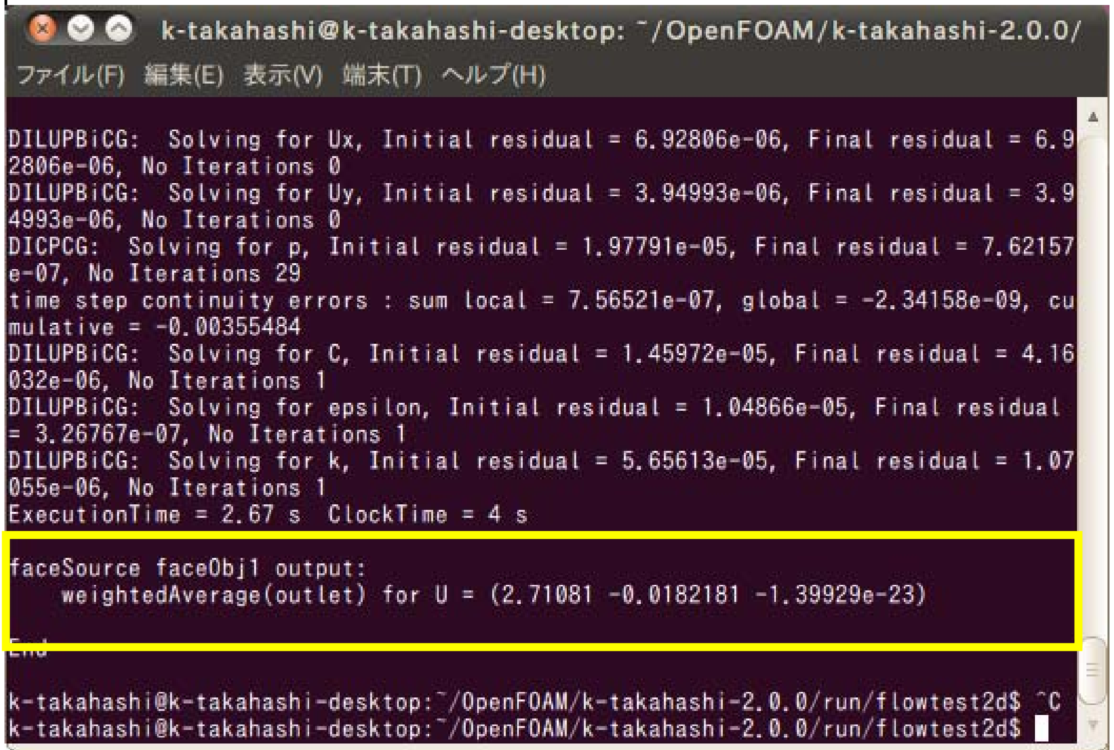



適当に書いたので、当然エラーが出る

"Weight field aa must be either a volScalarField or surfaceScalarField"

# もっと詳しくfunctionsを知るために（operation）

```
functions
{
   faceObj1
   {
      ・・・
      ・・・
      sourceName      outlet;
      operation  weightedAverage;
      weightField  phi;
    //phiはsurfaceScalarFieldの値
      fields
      (
       U
      );
   }
}
```




めでたく成功

重み付け平均 $$\overline{\mathbf{U}} = \frac{\sum_i \mathbf{U}_f(i)\cdot\phi(i)}{\sum_i \phi(i)}$$

疑問：$U_f(i)$はどこの値なのか・・・

近接セル値？補間値？

# もっと詳しくfunctionsを知るために

## Functionsが書かれたControlDictの例題を探す

Find $WM_PROJECT_DIR -name controlDict | xargs grep functions

```
k-takahashi@k-takahashi-desktop:~$ find $WM_PROJECT_DIR -name controlDict | xargs grep functions
/opt/openfoam200/tutorials/compressible/rhoPimpleFoam/les/pitzDaily/system/controlDict:functions
/opt/openfoam200/tutorials/compressible/sonicFoam/ras/nacaAirfoil/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/twoPhaseEulerFoam/bed/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/twoPhaseEulerFoam/bubbleColumn/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/twoPhaseEulerFoam/bed2/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/interDyMFoam/ras/sloshingTank3D3DoF/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/interDyMFoam/ras/sloshingTank3D/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/interDyMFoam/ras/sloshingTank2D3DoF/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/interDyMFoam/ras/sloshingTank2D/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/interDyMFoam/ras/sloshingTank3D6DoF/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/cavitatingFoam/les/throttle3D/system/controlDict:functions
/opt/openfoam200/tutorials/multiphase/cavitatingFoam/les/throttle/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pimpleDyMFoam/wingMotion/wingMotion2D_simpleFoam/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pimpleDyMFoam/wingMotion/wingMotion2D_pimpleDyMFoam/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pimpleFoam/TJunction/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pimpleFoam/TJunctionFan/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pisoFoam/les/pitzDaily/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/pisoFoam/les/pitzDailyDirectMapped/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/simpleFoam/pitzDaily/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/simpleFoam/motorBike/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/simpleFoam/pitzDailyExptInlet/system/controlDict:functions
/opt/openfoam200/tutorials/incompressible/channelFoam/channel395/system/controlDict:functions
/opt/openfoam200/tutorials/discreteMethods/dsmcFoam/supersonicCorner/system/controlDict:functions
/opt/openfoam200/tutorials/discreteMethods/dsmcFoam/freeSpacePeriodic/system/controlDict:functions
/opt/openfoam200/tutorials/discreteMethods/dsmcFoam/wedge15Ma5/system/controlDict:functions
/opt/openfoam200/tutorials/discreteMethods/dsmcFoam/freeSpaceStream/system/controlDict:functions
/opt/openfoam200/tutorials/combustion/XiFoam/les/pitzDaily/system/controlDict:functions
/opt/openfoam200/tutorials/combustion/XiFoam/les/pitzDaily3D/system/controlDict:functions
/opt/openfoam200/tutorials/lagrangian/LTSReactingParcelFoam/verticalChannel/system/controlDict:functions
/opt/openfoam200/tutorials/lagrangian/porousExplicitSourceReactingParcelFoam/verticalChannel/system/controlDict:functions
/opt/openfoam200/tutorials/basic/potentialFoam/cylinder/system/controlDict:functions
/opt/openfoam200/etc/controlDict:// NB: the #functions do not work here
/opt/openfoam200/src/postProcessing/functionObjects/field/fieldValues/controlDict:functions
/opt/openfoam200/src/postProcessing/functionObjects/field/fieldMinMax/controlDict:functions
/opt/openfoam200/src/postProcessing/functionObjects/field/fieldAverage/controlDict:functions
/opt/openfoam200/src/postProcessing/functionObjects/utilities/timeActivatedFileUpdate/controlDict:functions
/opt/openfoam200/src/postProcessing/functionObjects/IO/controlDict:functions
/opt/openfoam200/src/postProcessing/functionObjects/systemCall/controlDict:functions
```

38個
(tutorial:31, source:7)

# もっと詳しくfunctionsを知るために

## ソース・チュートリアルの例文にはこのほかのtypeのパターンもあり

| | |
|---|---|
| coded | v2.0.0の新機能 |
| dsmcFields | モンテカルロ専用？ |
| forcecoeffs | 抵抗係数？ |
| force | 抵抗力？ |
| partialWrite | ？ |
| writeRegisteredObject | no_writeのFieldを強制出力？ |
| systemCall | ？ |
| timeActivatedFileUpdate | ？ |

内容は未調査。必要に応じて今後調べます