

# layerAdditionRemovalの検討 (その1)

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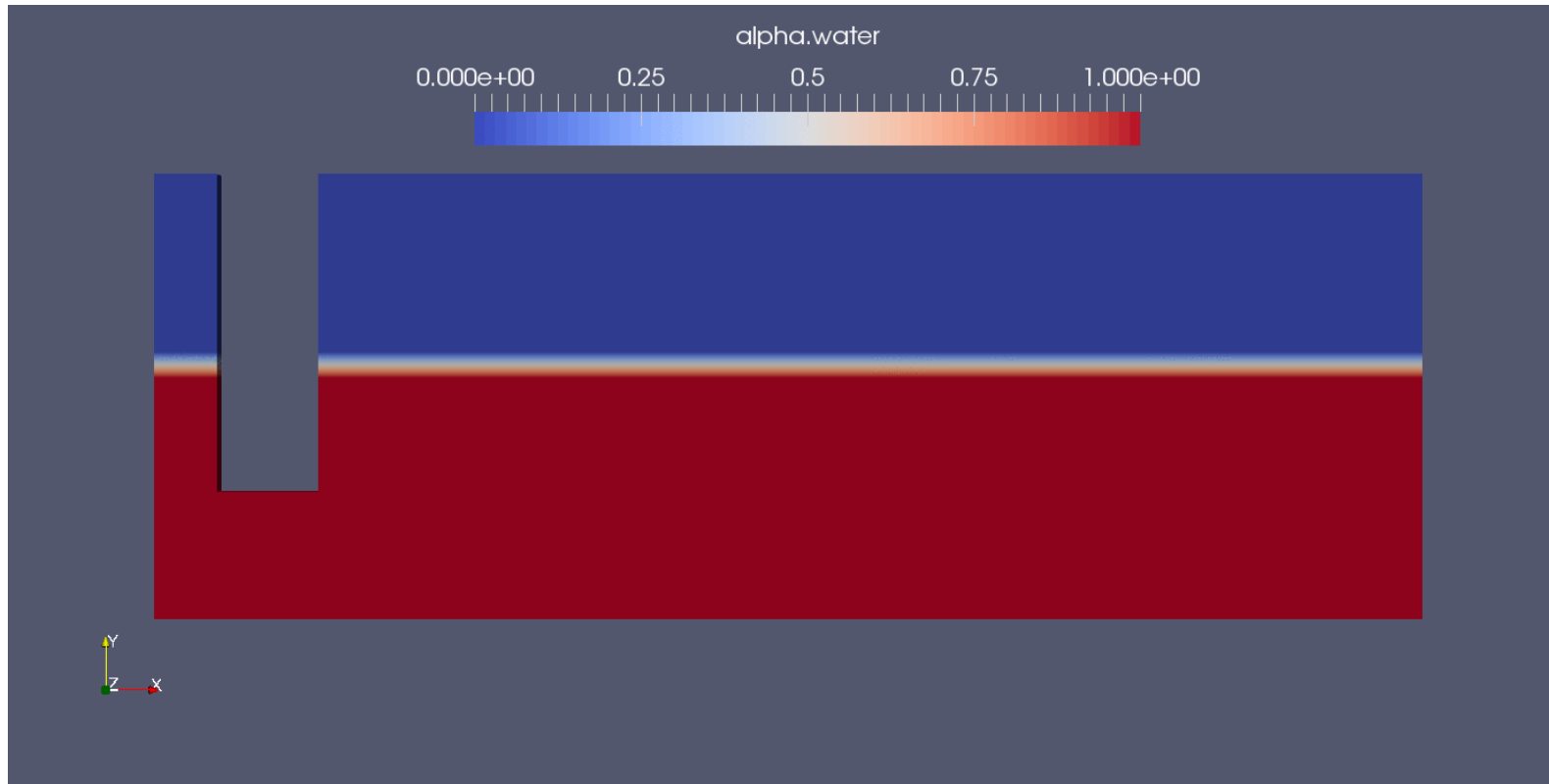
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# はじめに

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- OpenFOAMのengineFoamのメッシュはlayeredを基本的に用いており、圧縮・膨張行程でメッシュが伸長するだけであり、メッシュの追加や削除などの位相的な変化はない。（以下スプリングメッシュと言う）
- ただ、スプリングメッシュでは計算精度が著しく悪くなるので、位相的な変化が可能なメッシュ操作が必要。
- メッシュ増減が可能なライブラリとしてlayerAddirionRemovalがある。
- Ilya Sivkovのブログに詳しい使い方があったので、トレースしてみた。  
<https://ilyasivkov.wordpress.com/2015/04/23/dynamic-mesh-in-openfoam/>
- ベースのtutorialはinterDyMFoam/dambreak

# Model (OpenFoam ver.4.0)



100mm×35mmの領域の下部に貯水

8mm×25mmの矩形領域が往復運動

$$dx = A \sin\left(\frac{\pi t}{T}\right)$$

$$A = 82 \text{ [mm/s]}$$

$$T = 1.5 \text{ [s]}$$

<Solver>

interDyMFoam

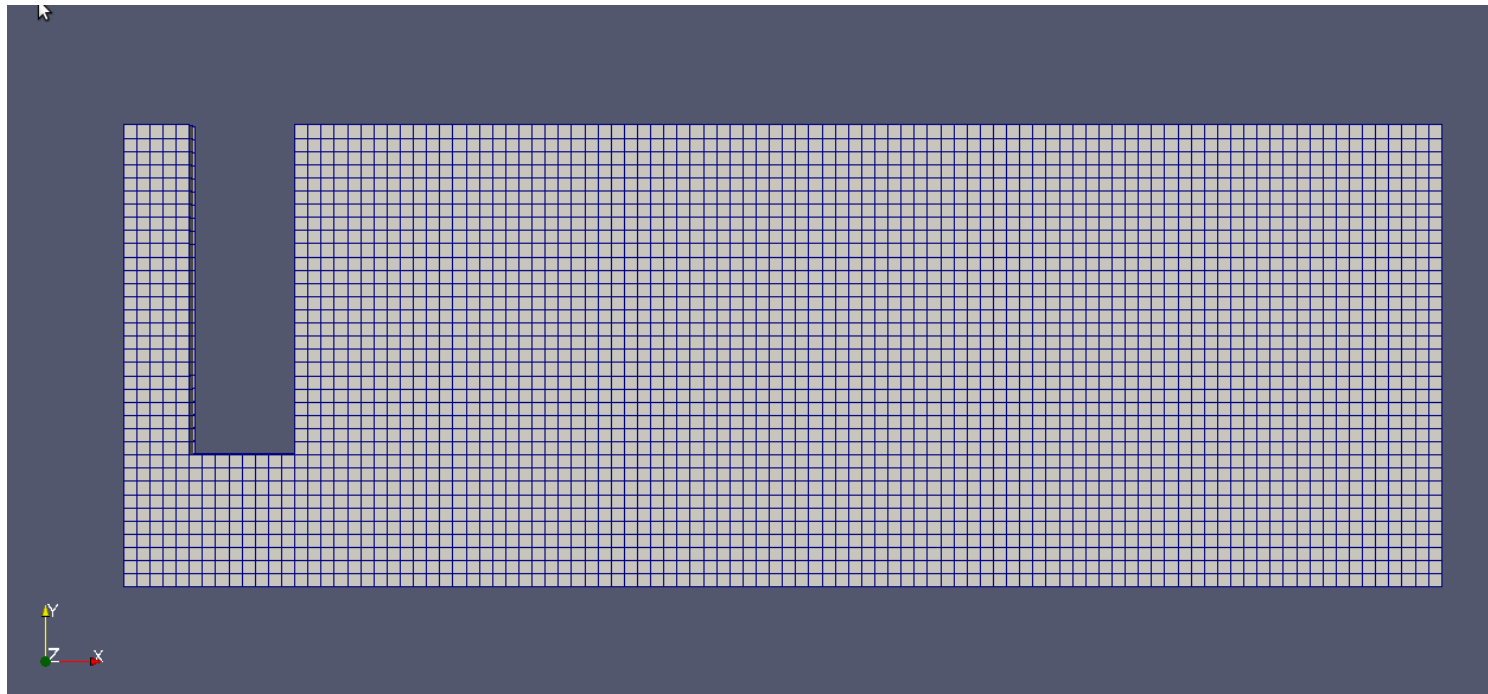
<dynamicMesh Library>

movingConeTopoFvMesh

layerAdditionRemoval

# mesh

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2次元

100mm×35mm

$dx=dy=dz=1\text{mm}$

Cells 3300

# blockMeshDict

---

```
convertToMeters 0.001;
vertices
(
(0.0 0 0) (0.0 0 1)
(5.0 0 0) (5.0 0 1)
(13.0 0 0) (13.0 0 1)
(100.0 0 0) (100.0 0 1)
(0.0 10.0 0) (0.0 10.0 1)
(5.0 10.0 0) (5.0 10.0 1)
(13.0 10.0 0) (13.0 10.0 1)
(100.0 10.0 0) (100.0 10.0 1)
(0.0 35.0 0) (0.0 35.0 1)
(5.0 35.0 0) (5.0 35.0 1)
(13.0 35.0 0) (13.0 35.0 1)
(100.0 35.0 0) (100.0 35.0 1)
);
```

```
blocks
(
hex (0 2 10 8 1 3 11 9) (5 10 1) simpleGrading (1 1 1)
hex (2 4 12 10 3 5 13 11) (8 10 1) simpleGrading (1 1 1)
hex (4 6 14 12 5 7 15 13) (87 10 1) simpleGrading (1 1 1)
hex (8 10 18 16 9 11 19 17) (5 25 1) simpleGrading (1 1 1)
hex (12 14 22 20 13 15 23 21) (87 25 1) simpleGrading (1 1 1)
);
edges
(
);
```

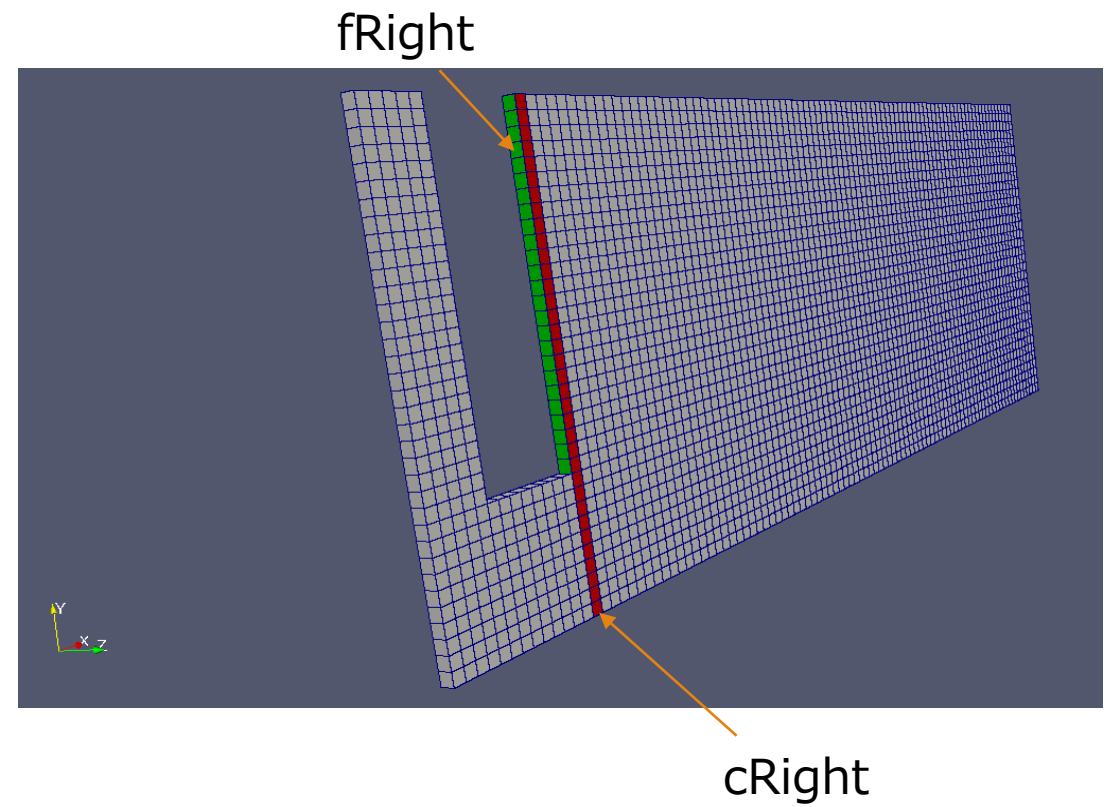
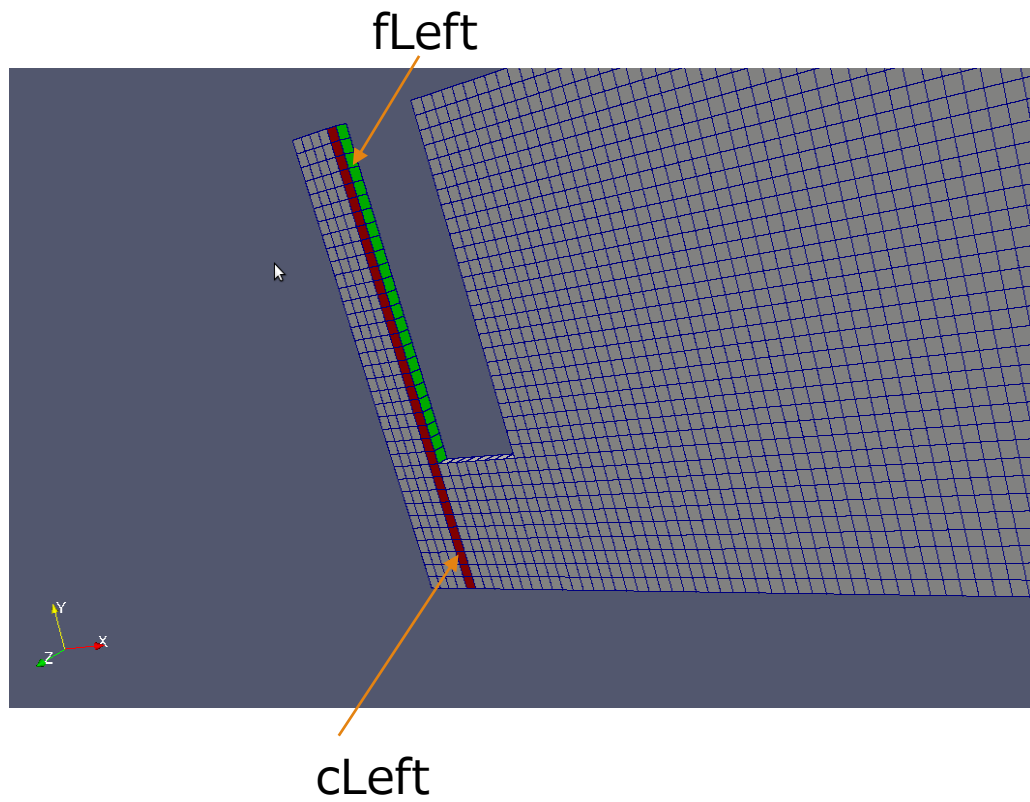
# blockMeshDict

---

```
boundary
(
  walls
  {
    type wall;
    faces
    (
      (0 2 3 1)
      (2 4 5 3)
      (4 6 7 5)
      (6 14 15 7)
      (14 22 23 15)
      (16 8 9 17)
      (8 0 1 9)
    );
  }
}
```

```
obstacle
{
  type patch;
  faces
  (
    (20 12 13 21)
    (12 10 11 13)
    (10 18 19 11)
  );
}
atmosphere
{
  type patch;
  faces
  (
    (22 20 21 23)
    (18 16 17 19)
  );
}
};
mergePatchPairs
(
);
```

# faceset, cellsetの指定



# topoSetDict

---

```
actions
(
{
name fLeft;
type faceSet;
action new;
source boxToFace;
sourceInfo
{
box (0.0049 0 0) (0.0051 0.035 0.001);
}
}

{
name fRight;
type faceSet;
action new;
source boxToFace;
sourceInfo
{
box (0.0129 0 0) (0.0131 0.035 0.001);
}
}

{
name cLeft;
type cellSet;
action new;
source boxToCell;
sourceInfo
{
box (0.004 0 0) (0.005 0.035 0.001);
}
}

{
name cRight;
type cellSet;
action new;
source boxToCell;
sourceInfo
{
box (0.013 0 0) (0.014 0.035 0.001);
}
}

{
name rightExtrusionFaces;
type faceZoneSet;
action new;
source setsToFaceZone;
sourceInfo
{
faceSet fRight;
cellSet cRight;
flip true;
}
}

{
name leftExtrusionFaces;
type faceZoneSet;
action new;
source setsToFaceZone;
sourceInfo
{
faceSet fLeft;
cellSet cLeft;
flip true;
}
}
);
```



# dynamicFvMeshDict

---

constantに入れる

```
dynamicFvMesh movingConeTopoFvMesh;

movingConeTopoFvMeshCoeffs
{
    motionVelAmplitude (0.082 0 0); // 82(mm/sec) through X axis
    motionVelPeriod 1.5; // SEMIperiod (sec)

    leftObstacleEdge 0;
    rightObstacleEdge 0;
    leftEdge 0;

}
```

# meshModifier

---

```
2
(  
right  
{  
type layerAdditionRemoval;  
faceZoneName rightExtrusionFaces;  
minLayerThickness 0.0008;  
maxLayerThickness 0.0012;  
oldLayerThickness -1;  
active on;  
}  
left  
{  
type layerAdditionRemoval;  
faceZoneName leftExtrusionFaces;  
minLayerThickness 0.0008;  
maxLayerThickness 0.0012;  
oldLayerThickness -1;  
active on;  
}  
);
```

- \$topoSet を実行後
- constant/polyMeshに入れる  
(その前に設置すると削除される)
- レイヤーの厚みが0.8mm以下でレイヤー削除
- レイヤーの厚みが1.2mm以上でレイヤー追加

# setFieldsDict

---

```
defaultFieldValues
(
    volScalarFieldValue alpha.water 0
    volVectorFieldValue U (0 0 0)
);

regions
(
    boxToCell
    {
        box (0 0 0) (0.100 0.02 0.001);
        fieldValues
        (
            volScalarFieldValue alpha.water 1
        );
    }
);
```

# fvSolution

```
solvers
{
  "alpha.water.*"
  {
    nAlphaCorr 2;
    nAlphaSubCycles 1;
    cAlpha 1;

    MULESCorr yes;
    nLimiterIter 3;

    solver smoothSolver;
    smoother symGaussSeidel;
    tolerance 1e-8;
    relTol 0;
  }

  pcorr
  {
    solver PCG;
    preconditioner DIC;
    tolerance 1e-5;
    relTol 0;
  }
}
```

```
pcorrFinal
{
  $pcorr;
  relTol 0;
}

p_rgh
{
  solver PCG;
  preconditioner DIC;
  tolerance 1e-07;
  relTol 0.05;
}

p_rghFinal
{
  $p_rgh;
  relTol 0;
}
```

赤字を追加

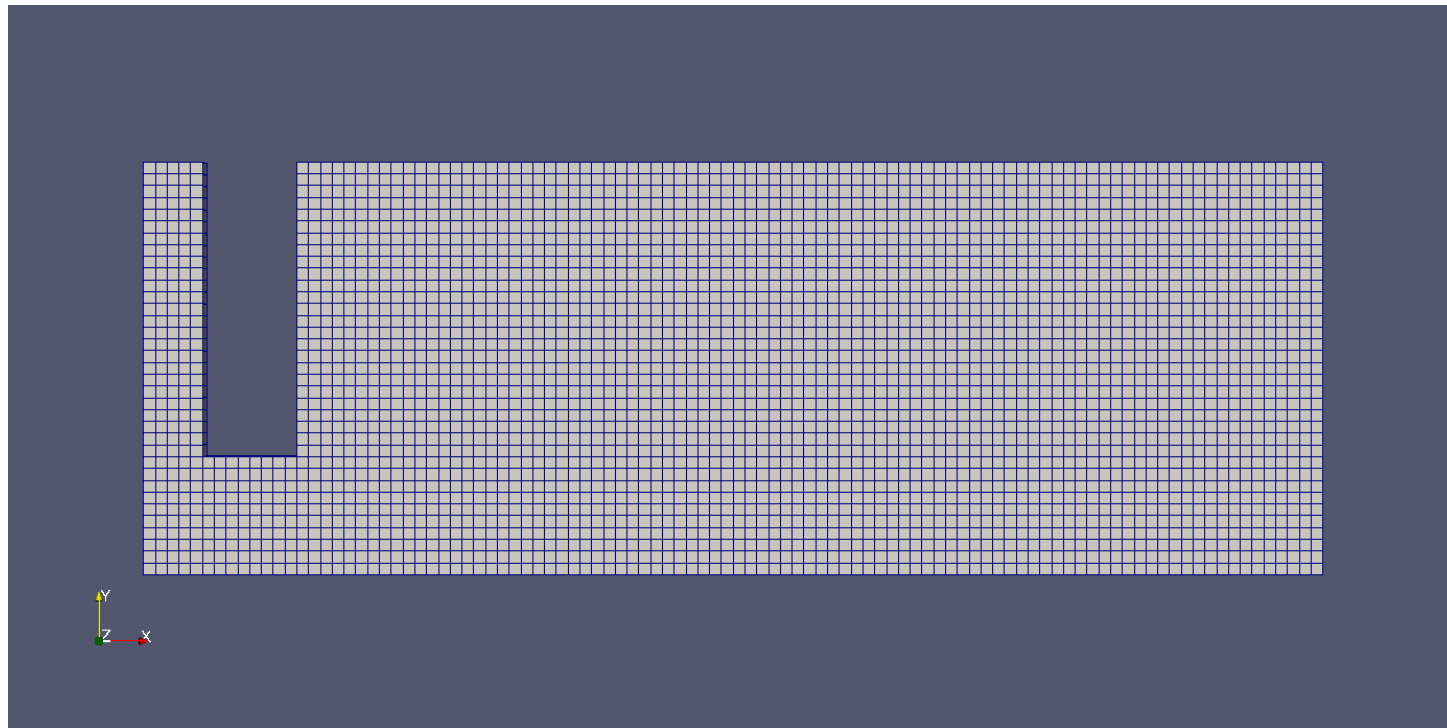
```
U
{
  solver smoothSolver;
  smoother symGaussSeidel;
  tolerance 1e-06;
  relTol 0;
}

PIMPLE
{
  momentumPredictor no;
  nOuterCorrectors 1;
  nCorrectors 3;
  nNonOrthogonalCorrectors 0;
}

relaxationFactors
{
  equations
  {
    ".*" 1;
  }
}
```

# Mesh

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# 終わりに

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- ・layerAdditionRemovalについてIliya Silvaの資料を参考にしてOpenFOAM4.0で再現。