Applied Computational Fluid Dynamics with OpenFOAM

Day – 9

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Contents

Kumaresh Selvakumar
kumaresh@exaslate.com

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Do the following

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3. Copy default cavity tutorial based from icoFoam
4. Add a new file for initial and boundary conditions
5. Add respective files in fvSchemes and fvSolution
6. Run your new case file
7. Upload your new solver, case files, and results in GITHUB

Kumaresh Selvakumar
kumaresh@exaslate.com

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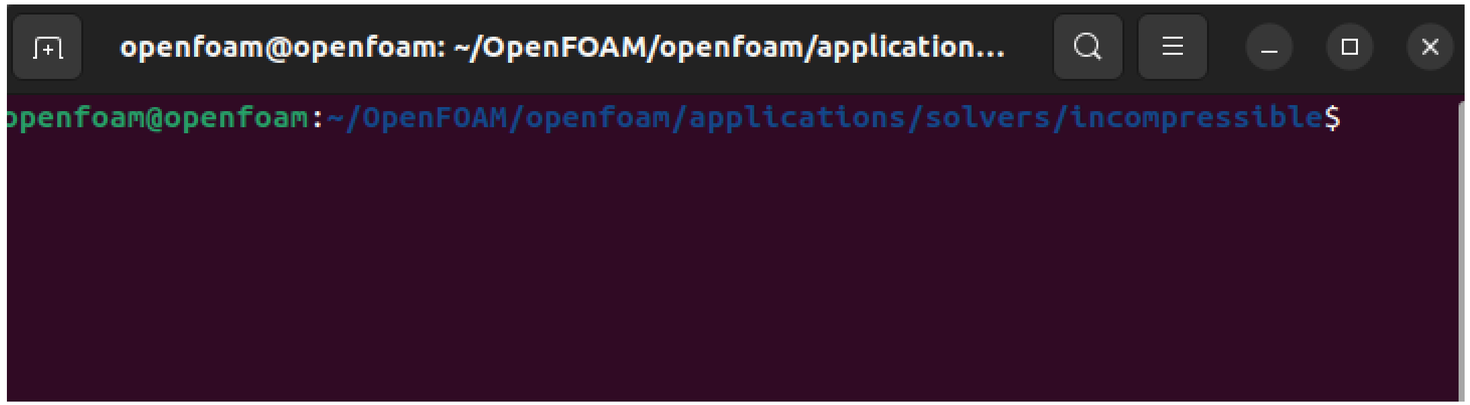
1. Copy default icoFoam solver

From the location:



To make your own solver, firstly do the following:

- Change the default icoFoam name into myIcoFoam.
- Change the source file name from icoFoam.C into myIcoFoam.C
- Open Files, and do the following:

  myIcoFoam.C

  EXE = $(FOAM_USER_APPBIN)/myIcoFoam

Kumaresh Selvakumar
kumaresh@exaslate.com

2. Adding the temperature field in the icoFoam solver

Under createFields.H

```
//Add here...
dimensionedScalar DT
(
    "DT",
    dimViscosity,
    transportProperties
);
```

```
Info<< "Reading field T\n" <<endl;
volScalarField T
(
    IOobject
    (
        "T",
        runTime.timeName(),
        mesh,
        IOobject::MUST_READ,
        IOobject::AUTO_WRITE
    ),
    mesh
);
```

Under myIcoFoam.C

```
//add these lines...
        fvScalarMatrix TEqn
        (
            fvm::ddt(T)
            + fvm::div(phi, T)
            - fvm::laplacian(DT, T)
        );

        TEqn.solve();
//done adding lines...
```

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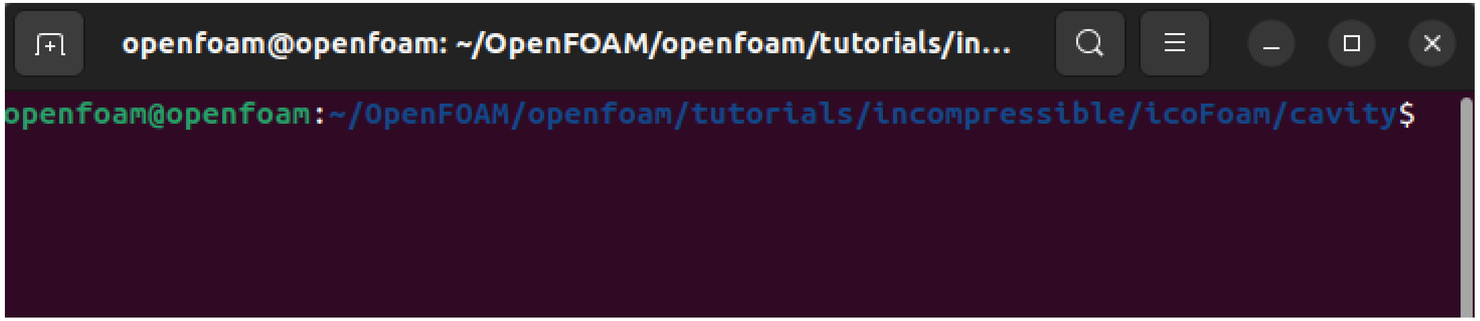
3. Copy default cavity tutorial based from icoFoam

From the location:



Modify your solver name as myCavityCaseFile

Kumaresh Selvakumar
kumaresh@exaslate.com

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4. Add a new file for initial and boundary conditions

Under constant/transportProperties

Add DT (new variable created)

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  v2306                                 |
|   \\  /    A nd           | Website:  www.openfoam.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       dictionary;
    object      transportProperties;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

nu              0.01;

DT              0.002;

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

Add “T” field in “0” file

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  v2306                                 |
|   \\  /    A nd           | Website:  www.openfoam.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       volScalarField;
    object      T;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [0 0 0 1 0 0 0];

internalField    uniform 300;

boundaryField
{
    movingWall
    {
        type        fixedValue;
        value       uniform 350;
    }

    fixedWalls
    {
        type        fixedValue;
        value       uniform 300;
    }

    frontAndBack
    {
        type        empty;
    }
}

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

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5. Add respective files in fvSchemes and fvSolution

Under system/fvSchemes

```
 8 FoamFile
 9 {
10     version     2.0;
11     format      ascii;
12     class       dictionary;
13     object      fvSchemes;
14 }
15 // * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //
16
17 ddtSchemes
18 {
19     default         Euler;
20 }
21
22 gradSchemes
23 {
24     default         Gauss linear;
25     grad(p)         Gauss linear;
26 }
27
28 divSchemes
29 {
30     default         none;
31     div(phi,U)      Gauss linear;
32     div(phi,T)      Gauss upwind;
33 }
34
35 laplacianSchemes
36 {
37     default         Gauss linear orthogonal;
38     laplacian(DT,T) Gauss linear corrected;
39 }
40
41 interpolationSchemes
42 {
43     default         linear;
44 }
45
46 snGradSchemes
47 {
48     default         orthogonal;
49 }
50
51
52 // ************************************************************************* //
```

Under system/fvSolution

```
solvers
{
    p
    {
        solver          PCG;
        preconditioner  DIC;
        tolerance       1e-06;
        relTol          0.05;
    }

    pFinal
    {
        $p;
        relTol          0;
    }

    T
    {
        solver          PBiCGStab;
        preconditioner  DILU;
        tolerance       1e-6;
        relTol          0.1;
    };

    U
    {
        solver          smoothSolver;
        smoother        symGaussSeidel;
        tolerance       1e-05;
        relTol          0;
    }
}

PISO
{
    nCorrectors     2;
    nNonOrthogonalCorrectors 0;
    pRefCell        0;
    pRefValue       0;
}

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

Kumaresh Selvakumar
kumaresh@exaslate.com

6. Run your new case file

```
Time = 0.4998

Courant Number mean: 0.00444052 max: 0.0170421
smoothSolver:  Solving for Ux, Initial residual = 1.5517e-09, Final residual = 1.5517e-09, No Iterations 0
smoothSolver:  Solving for Uy, Initial residual = 2.04474e-09, Final residual = 2.04474e-09, No Iterations 0
DICPCG:  Solving for p, Initial residual = 1.12694e-06, Final residual = 1.80179e-08, No Iterations 1
time step continuity errors : sum local = 6.5149e-13, global = -9.77893e-21, cumulative = -2.73277e-19
DICPCG:  Solving for p, Initial residual = 1.57304e-08, Final residual = 1.57304e-08, No Iterations 0
time step continuity errors : sum local = 5.69014e-13, global = -1.06475e-20, cumulative = -2.83925e-19
DILUPBiCGStab:  Solving for T, Initial residual = 2.59838e-05, Final residual = 5.04678e-10, No Iterations 1
ExecutionTime = 2.86 s  ClockTime = 3 s

Time = 0.4999

Courant Number mean: 0.00444052 max: 0.0170421
smoothSolver:  Solving for Ux, Initial residual = 1.56123e-09, Final residual = 1.56123e-09, No Iterations 0
smoothSolver:  Solving for Uy, Initial residual = 2.05631e-09, Final residual = 2.05631e-09, No Iterations 0
DICPCG:  Solving for p, Initial residual = 5.45261e-07, Final residual = 5.45261e-07, No Iterations 0
time step continuity errors : sum local = 1.96933e-11, global = 9.276e-21, cumulative = -2.74649e-19
DICPCG:  Solving for p, Initial residual = 5.61721e-07, Final residual = 5.61721e-07, No Iterations 0
time step continuity errors : sum local = 2.02877e-11, global = 2.35267e-20, cumulative = -2.51122e-19
DILUPBiCGStab:  Solving for T, Initial residual = 2.597e-05, Final residual = 5.04411e-10, No Iterations 1
ExecutionTime = 2.86 s  ClockTime = 3 s

Time = 0.5

Courant Number mean: 0.00444052 max: 0.0170421
smoothSolver:  Solving for Ux, Initial residual = 1.41142e-09, Final residual = 1.41142e-09, No Iterations 0
smoothSolver:  Solving for Uy, Initial residual = 1.86002e-09, Final residual = 1.86002e-09, No Iterations 0
DICPCG:  Solving for p, Initial residual = 1.02705e-06, Final residual = 1.63329e-08, No Iterations 1
time step continuity errors : sum local = 5.92229e-13, global = -6.97975e-21, cumulative = -2.58102e-19
DICPCG:  Solving for p, Initial residual = 1.42803e-08, Final residual = 1.42803e-08, No Iterations 0
time step continuity errors : sum local = 5.18098e-13, global = 2.40213e-20, cumulative = -2.34081e-19
DILUPBiCGStab:  Solving for T, Initial residual = 2.59562e-05, Final residual = 5.04142e-10, No Iterations 1
ExecutionTime = 2.86 s  ClockTime = 3 s

End

openfoam@openfoam:~/Documents/myCavityCaseFile$
```

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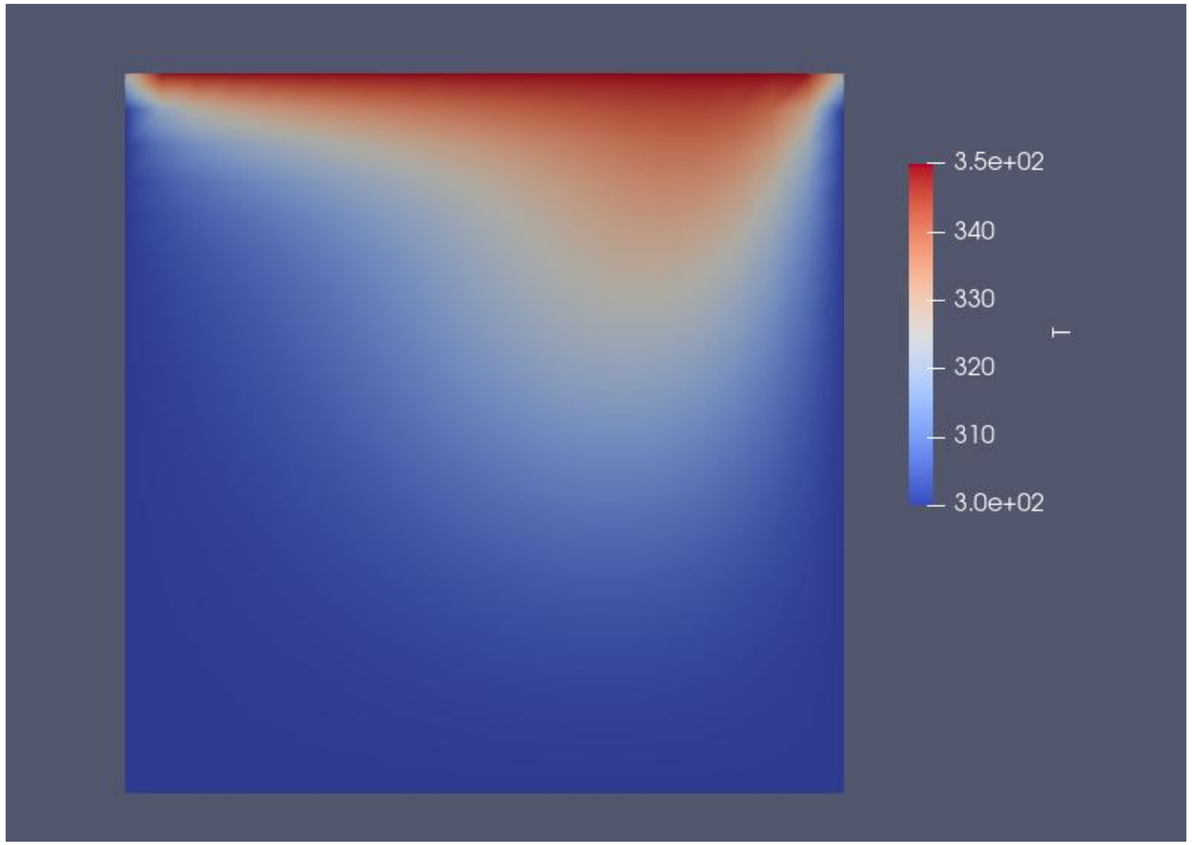

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THANK YOU