Flow past a cylinder

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Computational domain and boundary condition

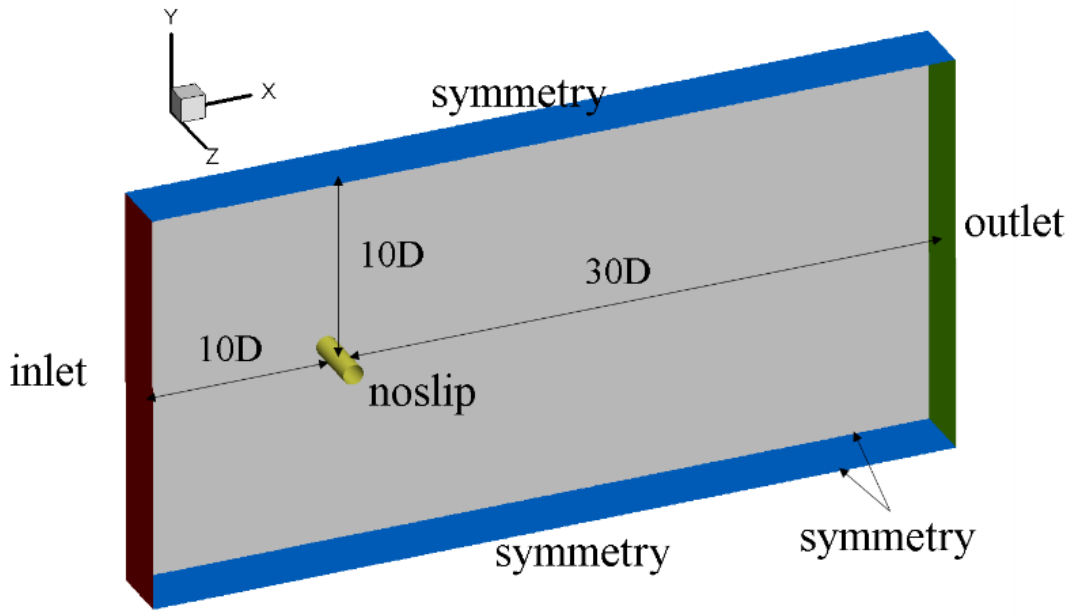


Fig. 1 The computational domain and boundary conditions.

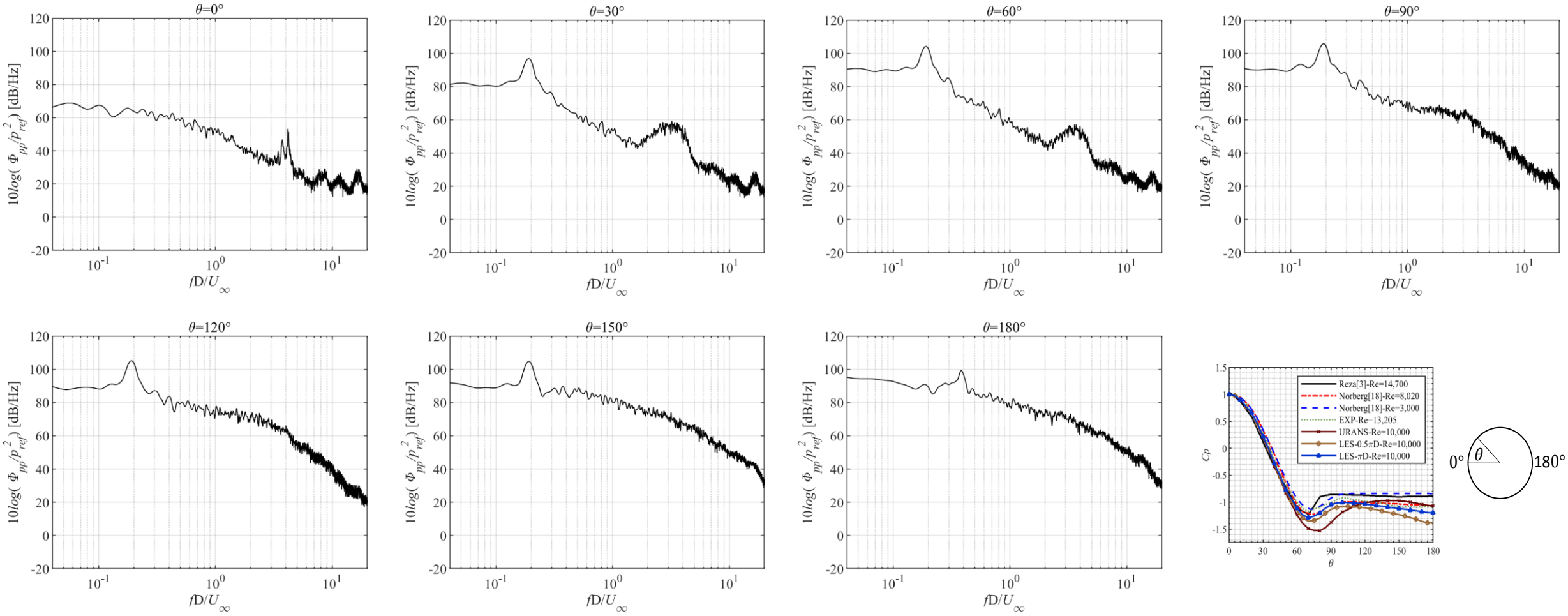
the averaged velocity of it is fixed to make sure the Reynolds number Re is 10,000, which is in the subcritical range. A **pressure outlet condition** is set for the outlet to allow pressure to convect beyond the computational domain. The cylinder surface is set to a **no-slip wall**. The top, bottom and two side boundaries are set to **symmetry conditions**.

Computational domain and boundary condition

```
libs
(
"libdynamicSmagorinskyModel.so"
);

application     pimpleFoam;

startFrom       startTime;

startTime       1.4;

stopAt          endTime;

endTime         2;

deltaT          0.000005;

writeControl    timeStep;

writeInterval   40000;

purgeWrite      0;

writeFormat     ascii;

writePrecision  8;

writeCompression off;

timeFormat      general;

timePrecision   8;

runTimeModifiable true;
```

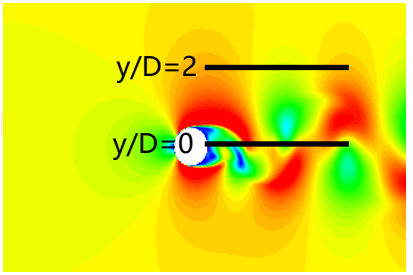
It is a incompressible case.
I use pimpleFoam solver.

Near field result



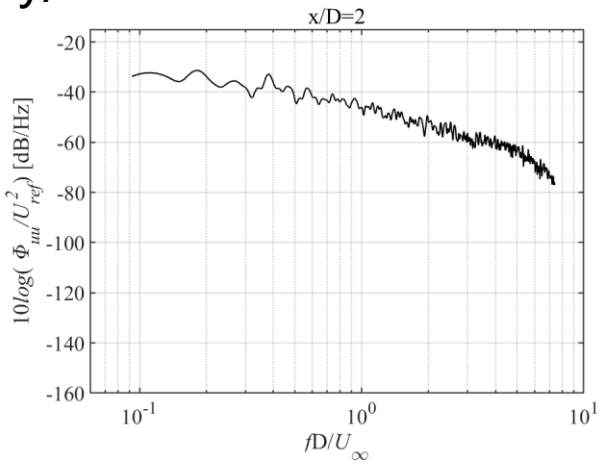
The pressure PSD value around the cylinder is reasonable. The tonal peak at St=0.2 is well captured, which is a feature for the flow past a cylinder in the subcritical Reynolds number range.

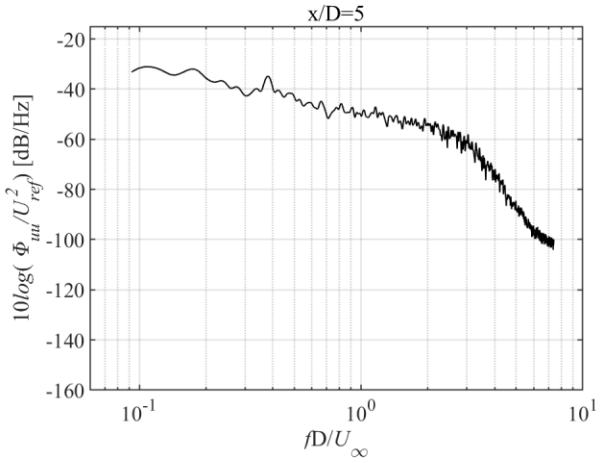
Near field result

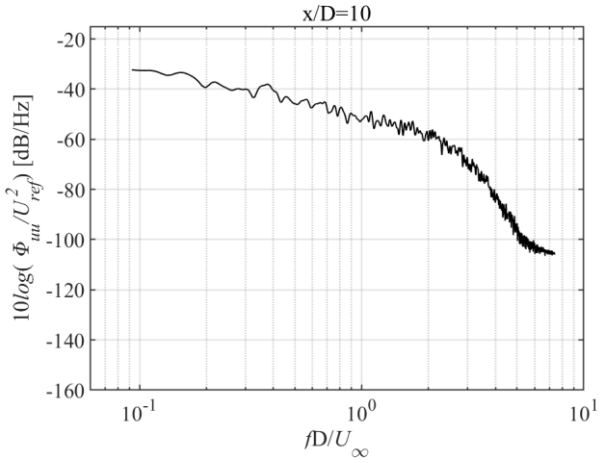


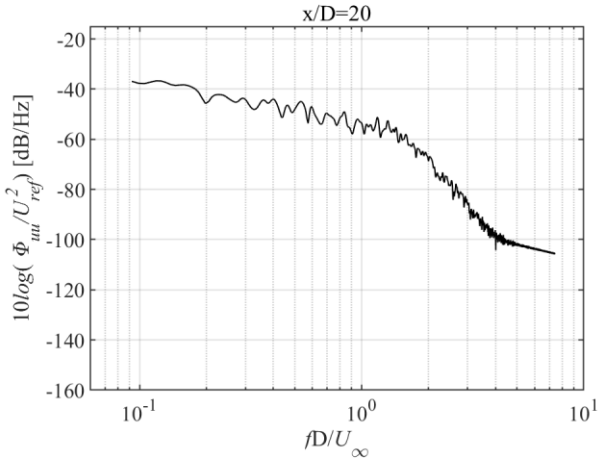
The velocity PSD in the flow field is also reasonable.

y/D=0

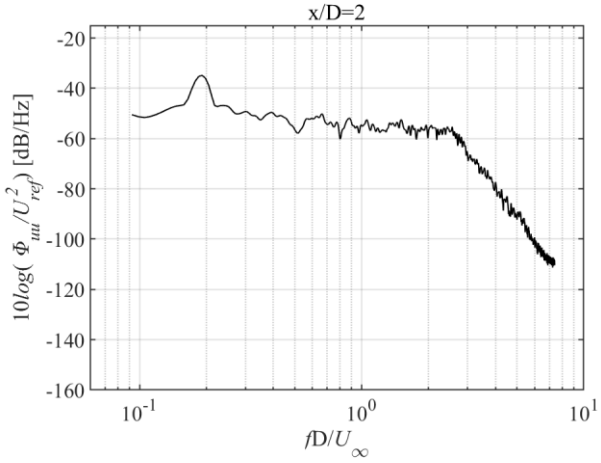


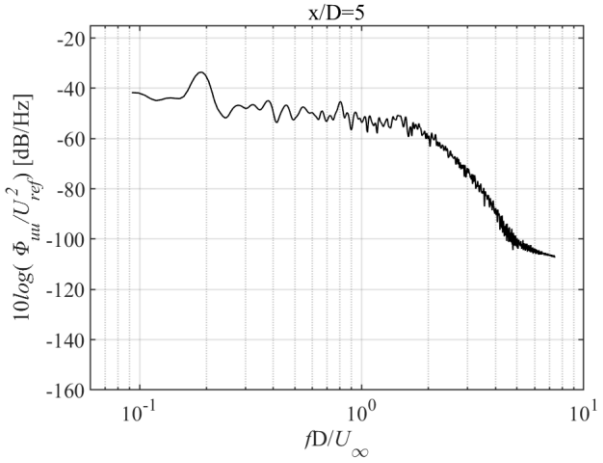


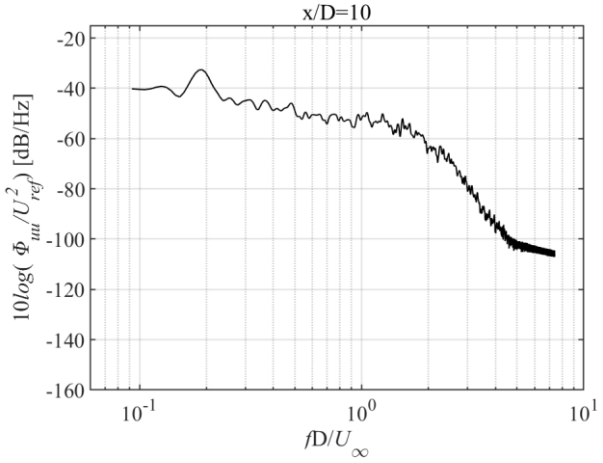


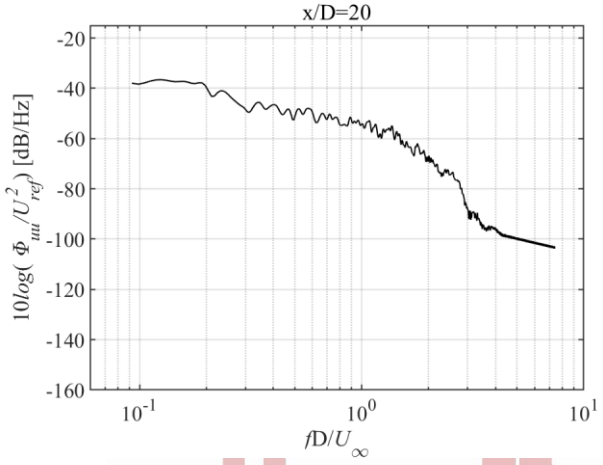


y/D=2









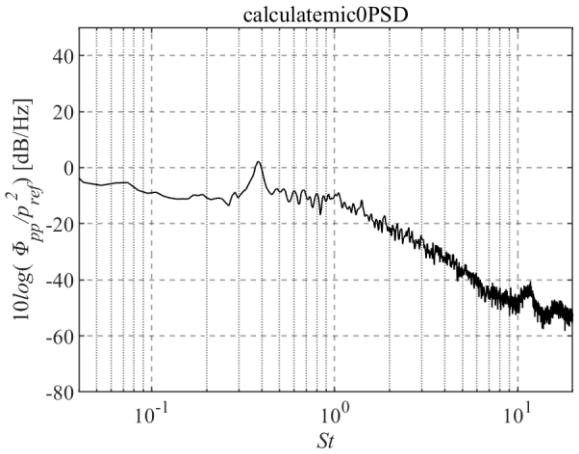
My curle set

```
CurleAnalogy1
{
    functionObjectLibs ("libAcoustics.so");

    type            Curle;

    log             true;

    order           second;

    probeFrequency  2;

    patches ("CYLINDER");

    interpolationScheme  cellPointFace;

    surfaces
    (
            CYLINDER
            {
                type            patch;
                patches         ("CYLINDER");
                interpolate     false;
            }
    );

    timeStart       0;

    timeEnd         10;

    c0              340;

    dRef            -1;

    pInf            0.0;

    pName           p;

    rho             rhoInf;

    rhoInf          1.205;

    CofR (0 0 0);

    cleanFreq 100;

    writeFft true;
```

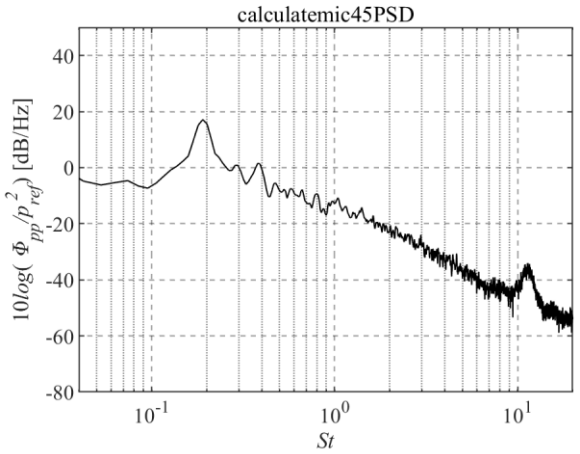
the centre of the cylinder

Observers are set 50 diameters far from the cylinder

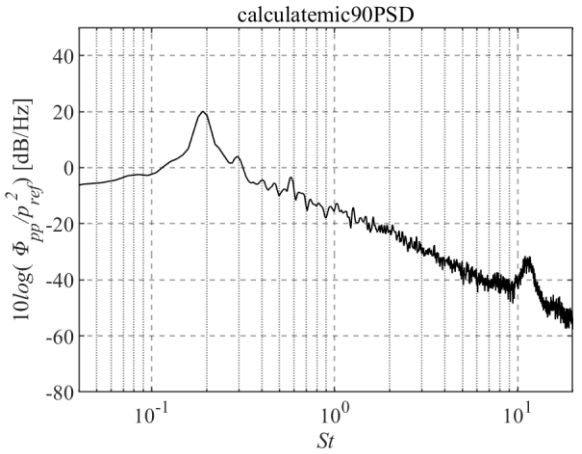
My curle result



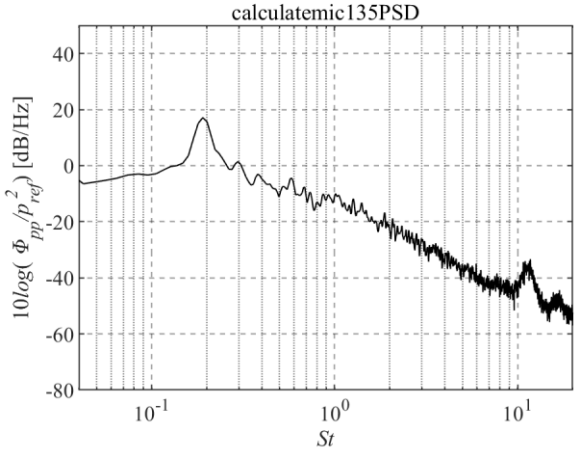
0°



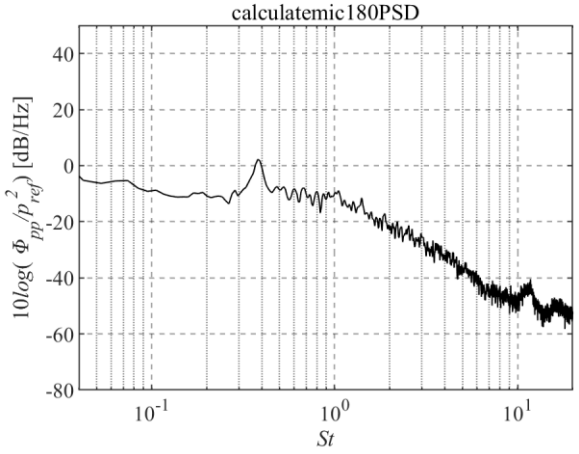
45°



90°



135°

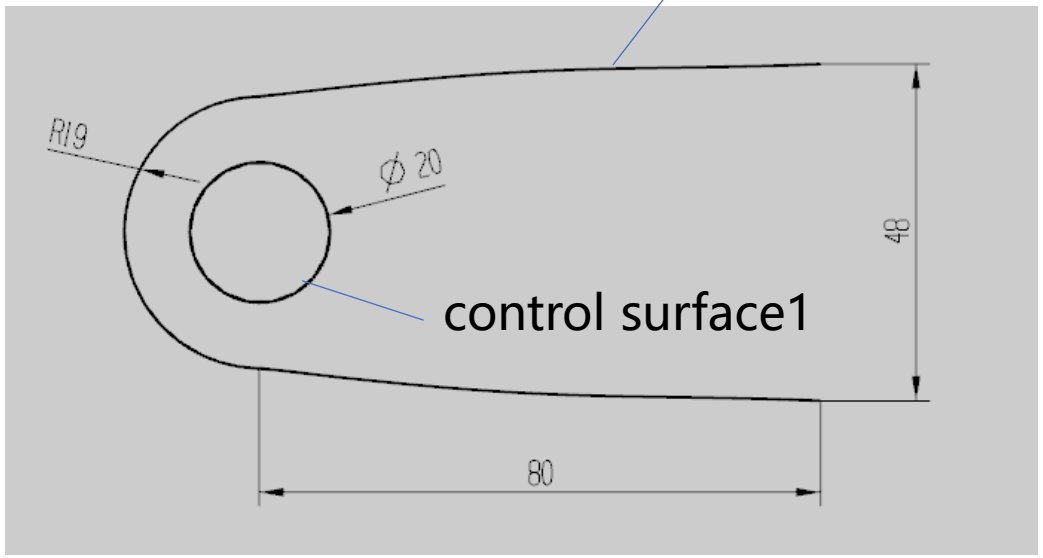


180°

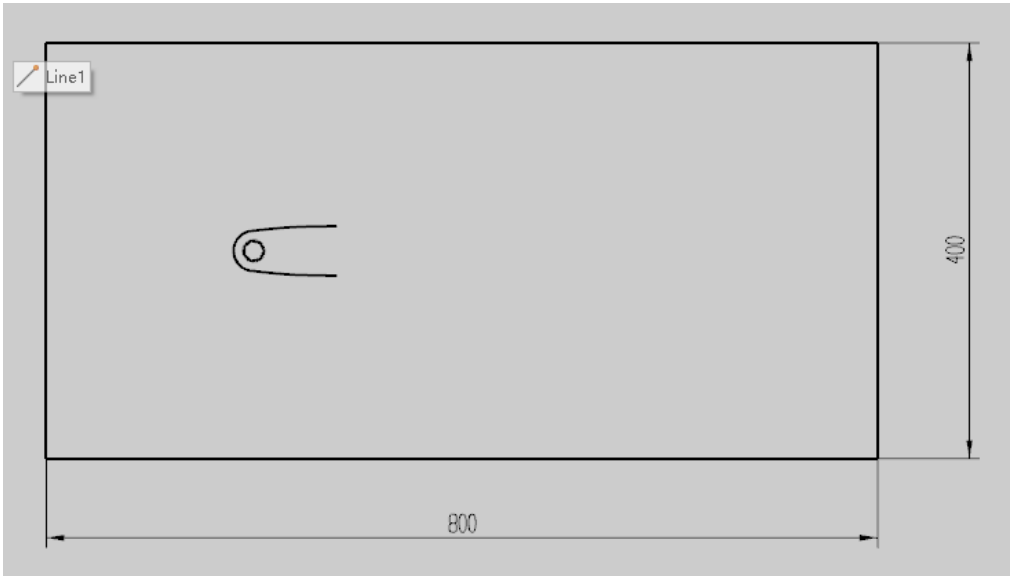
Curle result seems to be reasonable

My FWH set

control surface2



unit: mm



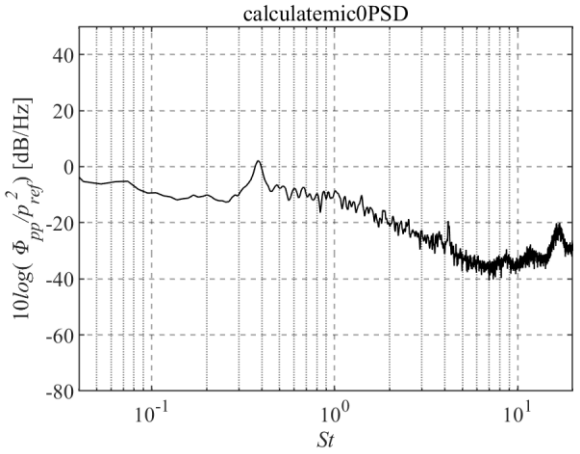
My FWH set

```
functionObjectLibs ("libAcoustics.so");

log             true;

writeFft        true;

probeFrequency  2;

timeStart       0;//0.0001;

timeEnd         10;

c0              340;

dRef            -1; //a coefficients for 2D case; set -1 for 3D cases

pName           p;

pInf            0;

rho             rhoInf;

rhoInf          1.205;

CofR (0 0 0);
```

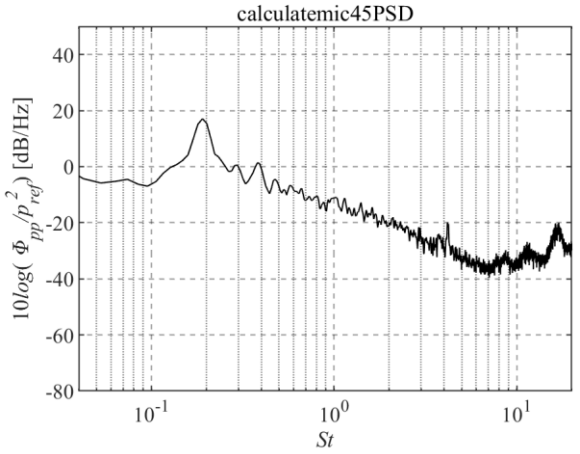
```
smallLEStrisurface_farassatresmall
{
        type            FfowcsWilliamsHawkings;
        #include        "fwhCommonSettings";
        patches ("CYLINDER");
        interpolationScheme cell;

        surfaces
        (
                CYLINDER1
                {
                    type            sampledTriSurfaceMesh;
                    surface         smallLES_trisurface_small2.stl;
                    source          cells;
                    interpolate     false;
                }
        );

        nonUniformSurfaceMotion false;
        U0              (0 0 0);
        Ufwh            (0 0 0);
        //7.572614108
        cleanFreq 100;
        formulationType Farassat1AFormulation;
        fixedResponseDelay true;
        responseDelay   1e-4;
}
```

My FWH result

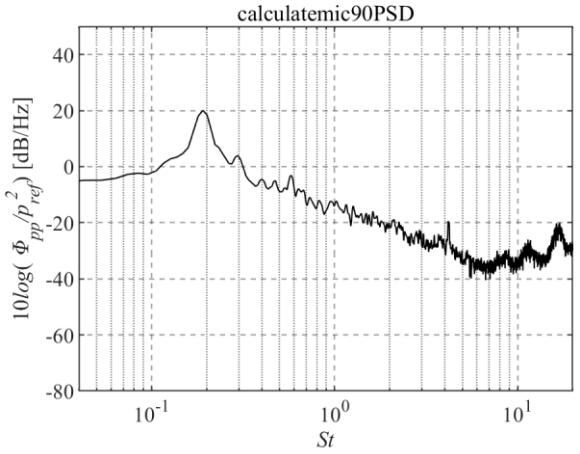
If the control surface is very close to the cylinder, the result is close to the curle result.



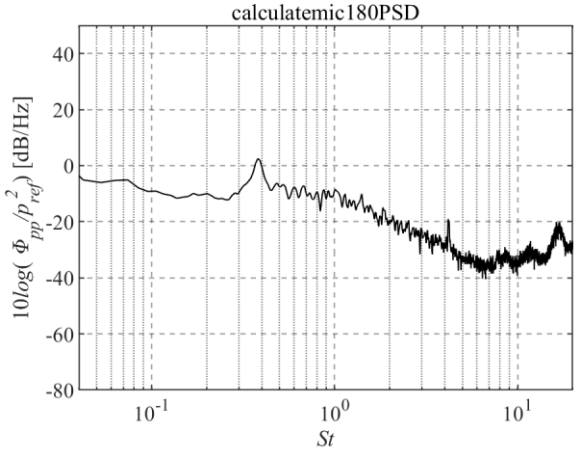
0°



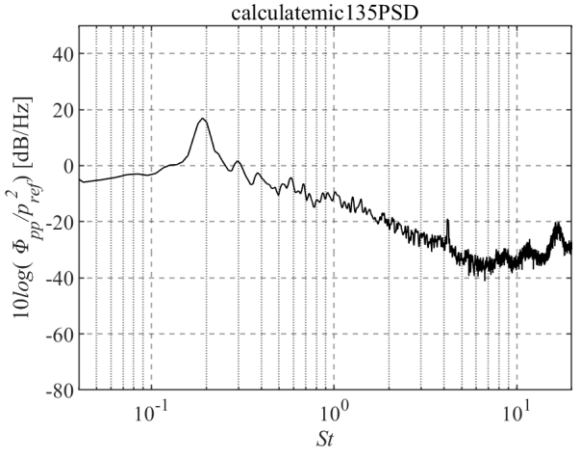
45°



90°



135°

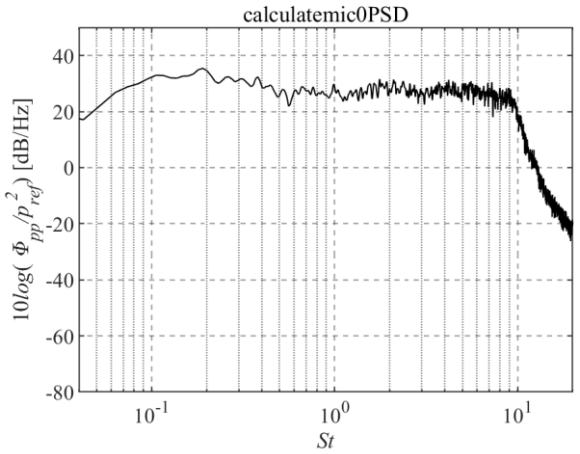


180°

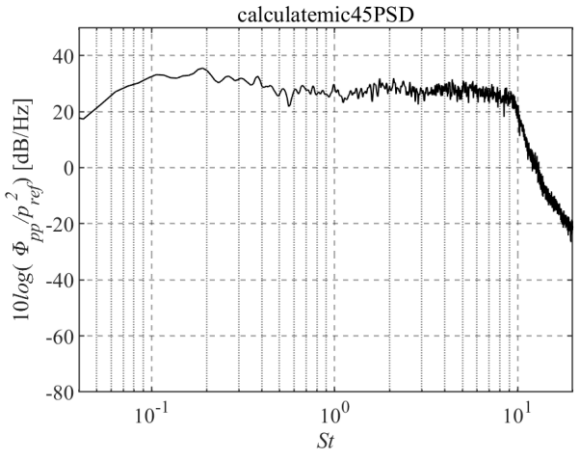
control surface1

My FWH result

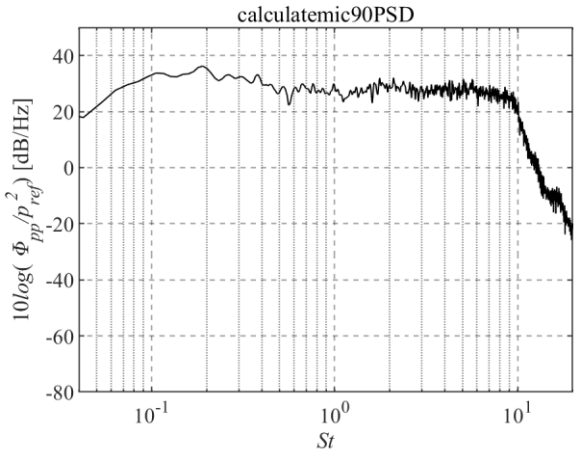
If the control surface is a little far from the cylinder, the fwh result would be bad.



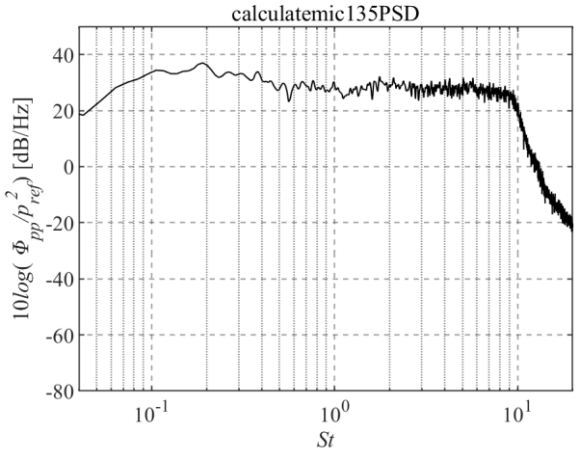
0°



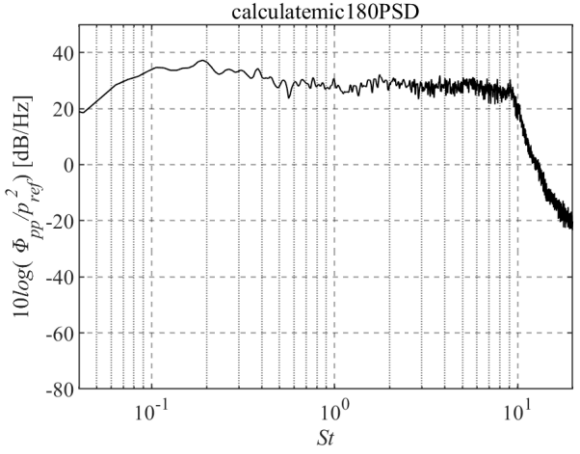
45°



90°



135°



180°

control surface2


University of
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