**Unsteady flow: Strouhal Number of the Vortex Shedding**

**How to obtain the Strouhal number**

Three probes were placed at varying positions in the wake. These probes captured pressure and velocity data at those specific locations. Firstly, the velocities were normalized to get the magnitude. Then, the power spectral density is calculated using Welch’s method, giving us the frequency of the pressure signal and the corresponding amplitude. We then find the index of the maximum amplitude, and from there we can see the dominant frequency. The Strouhal number is then calculated with the simple formula, St = d Freq \* D / mean velocity.

**The Strouhal Numbers**

Probe Locations

(7.5 2 0)

(8.5 2.5 0)

(8.5 1.5 0)

(9.5 3 0)

(9.5 1 0)

Polygon 4 Probe Strouhal Numbers

(8.5 2.5 0) 1.807409

(8.5 1.5 0) 1.807409

(9.5 3 0) 1.248315

Polygon 8 Probe Strouhal Numbers

(8.5 2.5 0) 2.002583

(8.5 1.5 0) 2.002583

(9.5 3 0) 0.955800

Polygon 16 Probe Strouhal Numbers

(8.5 2.5 0) 1.590302

(8.5 1.5 0) 1.590302

(9.5 3 0) 0.990650

Polygon 32 Probe Strouhal Numbers

(8.5 2.5 0) 1.189161

(8.5 1.5 0) 1.189161

(9.5 3 0) 0.994852

Our investigation into the simulated Strouhal Numbers compared with the anticipated value of around 0.17 from literature reveals huge inconsistencies across test cases. All simulated Strouhal Numbers were calculated using an identical mesh described in earlier sections, with probes placed in exact locations. Looking at the (9.5, 3, 0) probe specifically, it’s clear that the Strouhal Number converges for the mesh of the 16-sided polygon. This is consistent with the earlier findings, where the 16-sided polygon begins to have flow characteristics similar to that of a cylinder.

Possible errors in the Strouhal Number calculation compared to the calculation around a cylinder from OpenFoam assignment 2 are likely due to nperseg value differences. Additionally, a lack of mesh refinement past the edges of the polygon might be attributed to poor simulation data and simulated Strouhal Numbers.