**SLIDE 1**

Hello everyone, I’m Changkyu Park and my supervisors are: Dr Gerritsma, Yi and Varun of the Aerodynamics Department.

My research topic for the presentation is: The effect of alternative implementations of the forcing function in the Poisson problem using Spectral Element Method

And in this presentation, 2 different implementations will be analysed

**SLIDE 2**

Before proceeding further, I would like to list a few of my motivations behind this topic.

First, I saw potentials in numerical methods as they can take advantage of the rapidly improving computational power. According to Moore’s law, the computational power doubles every 2 years

Second, Poisson’s Equation has a broad range of use. From electro-magnetics to fluid- and aero-dynamics that we study in this faculty

Lastly, I wanted to see the difference in convergence of error when the forcing term is varied.

**SLIDE 3**

Let me introduce you to the system

I’ll only deal with 1-dimensional domain in this presentation for simplicity

So here you find the Poisson’s Equation that we often come across and Phi and f are scalar functions in which f is the source term

We then define another scalar function u which is the divergence of Phi

Then using this new function, we re-express the Poisson’s equation

**SLIDE 3**

Starting with the first implementation, calling it implementation A

Equation 1 and 2 are from the previous slide for reference

We re-evaluate the equation 1 by introducing anti-derivative, test function and boundary condition

Equation 2 is re-evaluated similarly.

**SLIDE 4**

Moving onto the 2nd implementation, implementation B,

The difference here is that we split the solution u into the homogeneous solution and particular solution.

Thus, Equation 1 is re-evaluated differently where parts of solution u are distributed to the left and the right hand side

In equation 2, the source term f is no longer present. This is due to the particular solution, up cancelling it out.

**SLIDE 5**

Now I will briefly talk about the discretization method.

So, Phi and u are discretized using reduction and reconstruction.

The involved test functions are: the edge basis functions and lagrange basis functions

**SLIDE 6**

Here are the results of the two different implementations for polynomial degree 3 on the left and degree 5 on the right.

The blue line represents the exact solution and the orange line represents the approximated solution.

It is clear that both implementations have almost or completely identical convergence.

**SLIDE 7**

Concluding, the variance of the source term implementation does not have a large effect in the approximation of Phi

However, further concrete conclusion is to be made only after analysis done in 2-dimensional domain