

NSM HOWTOCFD: Day 2: Spectral method-Hands-on session.

Consider the Poisson equation $\nabla^2 \psi = -\omega$, where ω is vorticity and ψ is streamfunction in a 2-dimensional physical space $(x, y) \in [0, 2\pi]^2$. Take a simple form of vorticity, i.e., $\omega(x, y) = \sin 5x$.

- a) Find the analytical solution for ψ and velocity \mathbf{u} .
- b) Use spectral method to find the solution for ψ and \mathbf{u} .
- c) Use the grid size resolution 128^2 ; 256^2 ; 512^2 & 1024^2 . Compare the error reduction both for ψ & \mathbf{u} with increasing resolution.
- d) Use Gauss-Seidel method to calculate ψ and \mathbf{u} .
- e) Compare the results for ψ & \mathbf{u} using Gauss-Seidel method and spectral method. Also compare the time taken by both the methods.

For these calculations use FFTW3 library at Param Seva. TAs will teach you how to call these libraries.