Introduction to Computational Fluid Dynamics using OpenFOAM and Octave

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(Session-9)

Instructions: Wed, Fri (4:30-5:30PM IST), Sat (4PM-5PM IST)
Query sessions: Sundays 9:00AM-9:30AM IST

Quick Recap

What Did We Discuss?

Rate of Convergence

$$\left(\frac{d\rho}{dx}\right)_i \approx \frac{\rho(x_{i+1}) - \rho(x_i)}{\Delta x_i} + O(\Delta x_i)$$

Δx	Error	Rate of convergence
0.1	0.16	-
0.05	0.0775	1.04
0.025	0.038125	1.02

$$\left(\frac{d\rho}{dx}\right)_i \approx \frac{\rho(x_{i+1}) - \rho(x_{i-1})}{2\Delta x_i} + O(\Delta x_i^2)$$

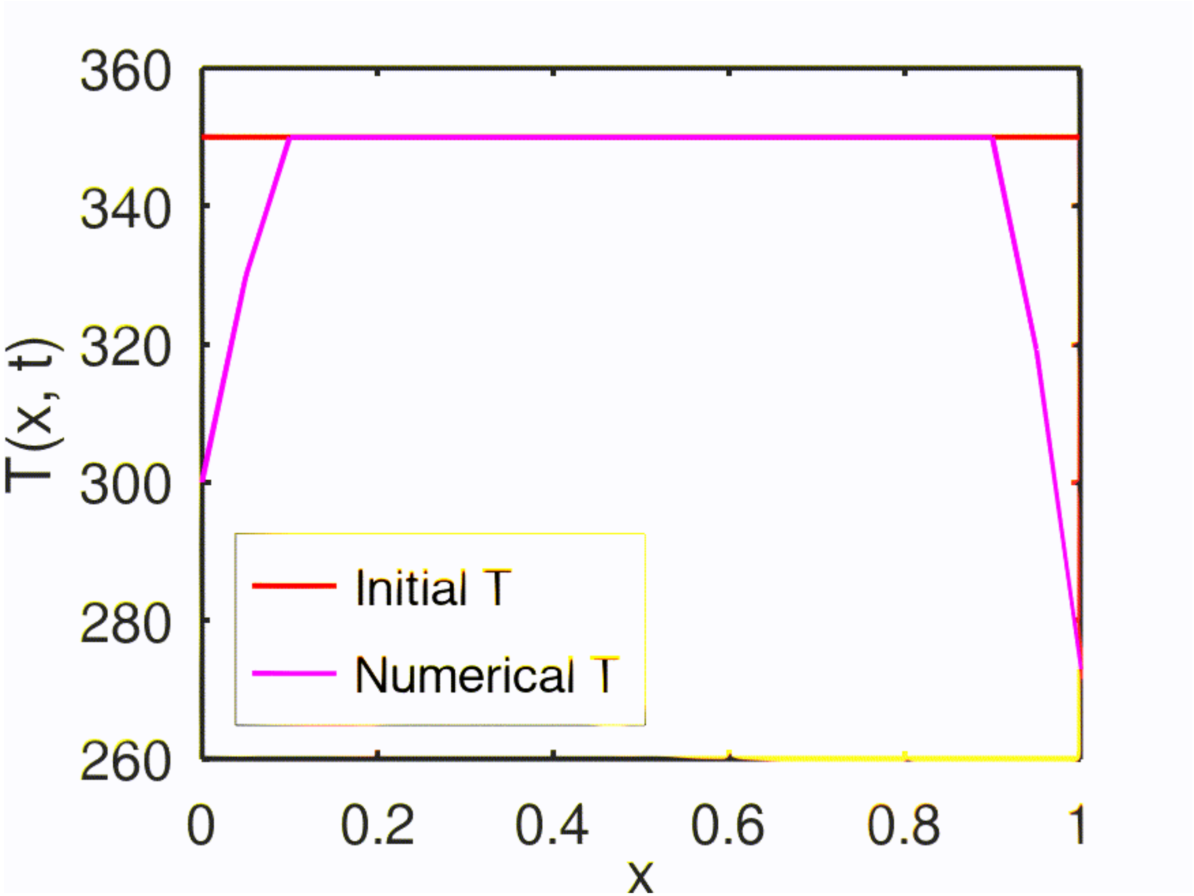
Δx	Error	Rate of convergence
0.1	0.01	-
0.05	0.0025	2
0.025	0.000625	2

Current Session

Overview

- Numerical Solution to Diffusion Equation
- Introduction to C++ for OpenFOAM (contd.)

Numerical Solution to Diffusion Equation



Numerical Solution to Diffusion Equation

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

$$\frac{T_i^{n+1} - T_i^n}{\Delta t} = \alpha \left(\frac{\partial^2 T}{\partial x^2}\right)_i^n$$

$$\boxed{\left(\frac{d^2 T}{dx^2}\right)_i = \frac{T(x_{i+1}) - 2T(x_i) + T(x_{i-1})}{\Delta x_i^2} + O\left(\Delta x_i^2\right)}$$

$$\frac{T_i^{n+1} - T_i^n}{\Delta t} = \alpha \frac{T_{i+1}^n - 2T_i^n + T_{i-1}^n}{\Delta x^2}$$

$$T_i^{n+1} = T_i^n + \Delta t \alpha \frac{T_{i+1}^n - 2T_i^n + T_{i-1}^n}{\Delta x^2}$$

a9_solve_diffusion.m

Introduction to C++ for OpenFOAM

b9_roc.cpp

Next Session

- Finite volume method to solve diffusion equation in OpenFOAM
- Introduction to C++ for OpenFOAM (Contd.)

Thank you