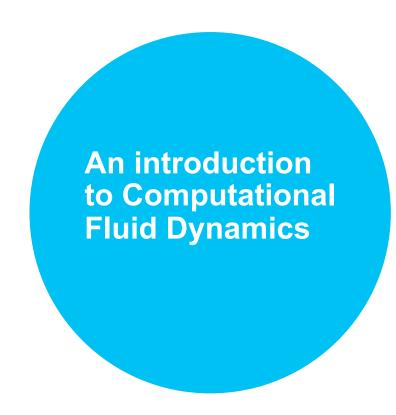
CFD 100 Series

Lecture 03:

Navier-Stokes Equations: Unsteady diffusion



1.1

有限差分法 Finite Difference Method 控制方程

$$\frac{\mathrm{d}^2 T}{\mathrm{d}^2 x} = H(T - T_{\infty})$$

• 空间项: 中心插分

$$\frac{\partial u}{\partial t} = \mu \frac{\partial^2 u}{\partial x^2} + S \to \frac{\partial u}{\partial t} = \mu \frac{\partial^2 u}{\partial x^2}$$

• 时间项: 一阶向前插分

• 空间项: 中心插分

1.1

有限差分法 Finite Difference Method

控制方程的离散

$$\frac{\partial u}{\partial t}$$

$$u_i^{n+1} = u_i^n + \Delta t \frac{\partial u}{\partial t} |_i^n + \frac{\Delta t}{2} \frac{\partial^2 u}{\partial t^2} |_i^n + \cdots$$

$$\frac{\partial u}{\partial t}\big|_{i}^{n} = \frac{u_{i}^{n+1} - u_{i}^{n}}{\Delta t} + \mathcal{O}(\Delta t)$$

$$\frac{\partial^2 u}{\partial x^2}$$
 ?

$$\frac{\partial^2 u}{\partial x^2} \Big|_i^n = \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{\Delta x^2} + \mathcal{O}(\Delta x^2)$$

$$\frac{\partial u}{\partial t} = \mu \frac{\partial^2 u}{\partial x^2}$$

$$\frac{u_i^{n+1} - u_i^n}{\Delta t} = \mu \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{\Delta x^2}$$

1.1

有限差分法 Finite Difference Method

控制方程的离散

$$\frac{u_i^{n+1} - u_i^n}{\Delta t} = \mu \frac{u_{i+1}^n - 2u_i^n + u_{i-1}^n}{\Delta x^2} \qquad u_i^{n+1} = u_i^n + \mu \frac{\Delta t}{\Delta x^2} (u_{i+1}^n - 2u_i^n + u_{i-1}^n)$$

