# Introduction

The objective of this assignment is to perform the numerical calculation of the heat equation in one spatial dimension, defined in Equation 1. This equation describes the diffusion of a passive scalar in a field for any number of spatial dimensions.

Equation . 1D Heat Equation.

For the domain of this assignment is a simulated wall of a given thickness originally at a given temperature. The wall has a known diffusion of the heat transfer or temperature difference. In the transient simulation, the sides of the wall are suddenly increased to a given temperature, bringing the temperature of the wall up to some value. These values are summarized in Table 1.

Table . Conditions of Transient Analysis.

|  |  |
| --- | --- |
| Parameter | Value |
| (L) Thickness of the simulated wall | 0.3 [m] |
| (T0) Initial uniform temperature of the wall | 100 [K] |
| (α) Heat diffusivity | 3e-6 [m2/s] |
| (Tw) Sudden Wall Temperature | 300 [K] |

# Forward in Time, Central in Space Solution (FTCS)

## FTCS Method

This method is a simple explicit formulation of a discretized heat equation. The step is a central second order derivative in space for a forward step in time, hence the name, described in Equation 2.

Equation . FTCS Discretization of 1D Heat Equation. n is the time step, and j is the spatial point.

This scheme’s stability is determined by a parameter, , although some references refer to it as . The FTCS scheme is stable for .

Equation . S Parameter for FTCS.

The accuracy of the scheme can come from its Truncation Error (TE). This TE would suggest that the method is first (1st) order accurate in time and second (2nd) order accurate in space

Equation . Truncation Error for FTCS.

## Calculation Method

Within the git repository for this class, there are some

# Works Cited

1. Anderson, D. A., Tannehill, J. C, Pletcher, R. H., Munipalli, R., and Shankar, V. (2021). Computational Fluid Mechanics and Heat Transfer. *Series in Computation and Physical Processes in Mechanics and Thermal Sciences.* 4th Edition, CRC Press.