The Effect of Burner Size on Pan Temperature Distribution

Mathematical Model

Overview of the steps to obtaining a numerical solution of the temperature distribution in a pan above a burner.

Heat Conduction
Convective Heat Transfer

Physical Modelling

Numerical Modelling

$$\begin{cases} \rho c \dot{T}(\mathbf{x},t) = k\nabla^2 T(\mathbf{x},t) & \text{in} \quad \Omega \\ \mathbf{q}\cdot\mathbf{n} = h\Delta T(\mathbf{x},t) & \text{on} \quad \partial\Omega \end{cases}$$

Scientific Computing

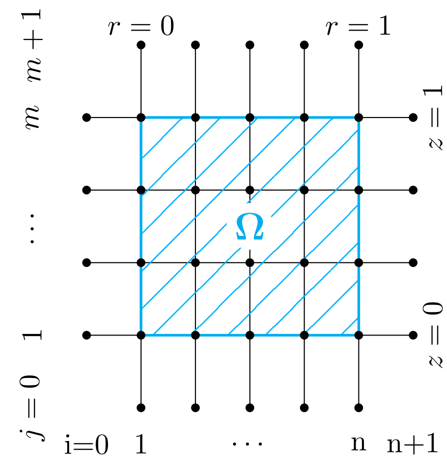
$$\mathbf{A}\vec{T} = \vec{b} \xrightarrow{\text{Scientific Computing}} \textbf{Numerical Solution: } T_{i,j}$$

Discretization

Since computers work in discrete units, computing a solution to the model requires a representation of the continuous domain.

Visualization of the discretization $T(r,z) \rightarrow T_{i,j}$ on Ω including ghost points for $n = 5$, $m = 4$.

Each $\bullet$ in Ω is a $T_{i,j}$ and each $\bullet$ outside is a ghost point. The grid is nonuniform to capture features at different resolutions in r and z.



Summary of Results

Numerical solutions of the conduction model for many combinations of parameter values gave insight into burner size effects on temperature distribution.

a: Temperature profiles for burner radii of 0, $r_p/2$, and r_p. Close proximity of all three lines indicates even pan heating.

b: Temperature profiles at constant burner radius. Flatter curves indicate a more even heat distribution.

c: Visualization of the full radial temperature distribution's dependence on burner radius. The most even temperature distributions are for the smallest radius burner considered, and for about 70% of r_p.