

Solution of 1D parabolic partial differential equation

Transient heating of a sphere-explicit method

Model problem 2

$$T_t := T_{rr} + \frac{2}{r}T_r$$

$$\text{Biot} := 10 \quad n := 5 \quad m := 10 \quad L := 1 \quad T_i := 1$$

$$f(r) := 0$$

$$\text{Heat}(f, L, T_i, n, m, \text{Biot}) := \left| \begin{array}{l} \text{dr} \leftarrow \frac{L}{n} \\ \text{dt} \leftarrow \frac{T_i}{m} \\ r_3 \leftarrow 1 - 2 \cdot \frac{\text{dt}}{\text{dr}^2} \\ \text{for } i \in 0..n \\ \quad r_i \leftarrow \text{dr} \cdot i \\ \text{for } j \in 0..m \\ \quad t_j \leftarrow \text{dt} \cdot j \\ \text{for } i \in 1..n-1 \\ \quad \left| \begin{array}{l} r1_i \leftarrow \frac{\text{dt}}{\text{dr}^2} + \frac{\text{dt}}{\text{dr} \cdot r_i} \\ r2_i \leftarrow \frac{\text{dt}}{\text{dr}^2} - \frac{\text{dt}}{\text{dr} \cdot r_i} \end{array} \right. \\ \text{for } i \in 0..n \\ \quad T_{i,0} \leftarrow f(r_i) \\ \text{for } j \in 0..m-1 \\ \quad \left| \begin{array}{l} \text{for } i \in 1..n-1 \\ \quad T_{i,j+1} \leftarrow r3 \cdot T_{i,j} + r1_i \cdot T_{i+1,j} + r2_i \cdot T_{i-1,j} \\ T_{0,j+1} \leftarrow T_{1,j+1} \\ T_{n,j+1} \leftarrow \frac{\text{Biot} \cdot \text{dr} + T_{n-1,j+1}}{1 + \text{dr} \cdot \text{Biot}} \end{array} \right. \end{array} \right|$$

$T^T$

Temp =

	0	1	2	3	4	5
0	0	0	0	0	0	0
1	0	0	0	0	0	0.667
2	0	0	0	0	2.083	1.361
3	0	0	0	6.944	-4.08	-0.693
4	0	0	26.042	-41.377	27.174	9.725
5	130.208	130.208	-259.332	299.491	-155.888	-51.296
6	$-1.817 \cdot 10^3$	$-1.817 \cdot 10^3$	$2.323 \cdot 10^3$	$-2.15 \cdot 10^3$	$1.025 \cdot 10^3$	342.266
7	$1.889 \cdot 10^4$	$1.889 \cdot 10^4$	$-1.963 \cdot 10^4$	$1.589 \cdot 10^4$	$-7.061 \cdot 10^3$	$-2.353 \cdot 10^3$
8	$-1.737 \cdot 10^5$	$-1.737 \cdot 10^5$	$1.617 \cdot 10^5$	$-1.198 \cdot 10^5$	$5.068 \cdot 10^4$	$1.689 \cdot 10^4$
9	$1.503 \cdot 10^6$	$1.503 \cdot 10^6$	$-1.313 \cdot 10^6$	$9.176 \cdot 10^5$	$-3.745 \cdot 10^5$	$-1.248 \cdot 10^5$
10	$-1.258 \cdot 10^7$	$-1.258 \cdot 10^7$	$1.057 \cdot 10^7$	$-7.107 \cdot 10^6$	$2.828 \cdot 10^6$	$9.428 \cdot 10^5$
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