Conditions Limites gauche et droite de Neumann discrétisée par un schéma centré

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> restart : with(LinearAlgebra) :
> L := 20;  H := 20;  ndx := 3;  ndy := 3;
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$$L := 20$$
$$H := 20$$
$$ndx := 3$$
$$ndy := 3 \qquad (1.1)$$

```
> Tb := 10;  Th := 30;  α[g] := 0;  α[d] := 0
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$$Tb := 10$$
$$Th := 30$$
$$\alpha_g := 0$$
$$\alpha_d := 0 \qquad (1.2)$$

$> \Delta x := \frac{L}{ndx};\ \Delta y := \frac{H}{ndy};\ \beta := \frac{\Delta x}{\Delta y}$

$$\Delta x := \frac{20}{3}$$
$$\Delta y := \frac{20}{3}$$
$$\beta := 1 \qquad (1.3)$$

$> i_{max} := ndx + 1;\quad j_{max} := ndy + 1;$

$$i_{max} := 4$$
$$j_{max} := 4 \qquad (1.4)$$

$> N := (i_{max} - 2)\cdot(j_{max} - 2) + 2\cdot(j_{max} - 2);$

$$N := 8 \qquad (1.5)$$

(1.6)

$>$ **for** i **from** 1 **to** i_{max} **do** $T[i, 1] := Tb$ **end do**;

$$T_{1,1} := 10$$
$$T_{2,1} := 10$$
$$T_{3,1} := 10$$
$$T_{4,1} := 10 \qquad (1.7)$$

$>$ **for** i **from** 1 **to** i_{max} **do** $T[i, j_{max}] := Th$ **end do**;

$$T_{1,4} := 30$$
$$T_{2,4} := 30$$
$$T_{3,4} := 30$$
$$T_{4,4} := 30 \qquad (1.8)$$

```
k := 1 :
 for j from 2 to j_max − 1 do
    T[0, j] := T[2, j] − 2·α[g]·Δx :
    Eq[k] := −2·(1 + β^2)·T[1, j] + T[2, j] + T[0, j] + β^2·(T[1, j + 1] + T[1, j
  − 1]) = 0 :
    Temps[k] := T[1, j] :
    k := k + 1 :
    for i from 2 to i_max -1 do
          Eq[k] := −2·(1 + β^2)·T[i, j] + T[i + 1, j] + T[i − 1, j] + β^2
  ·(T[i, j + 1] + T[i, j-1]) = 0 :
          Temps[k] := T[i, j] :
          k := k + 1 :
    end do:
    T[i_max + 1, j] := T[i_max − 1, j] + 2·α[d]·Δx :
    Eq[k] := −2·(1 + β^2)·T[i_max, j] + T[i_max − 1, j] + T[i_max + 1, j] + β^2
  ·(T[i_max, j + 1] + T[i_max, j − 1]) = 0 :
    Temps[k] := T[i_max, j] :
    k := k + 1 :
end do: =
```

> for k from 1 to N do Eq[k] end do;

$$-4\,T_{1,\,2} + 2\,T_{2,\,2} + T_{1,\,3} + 10 = 0$$
$$-4\,T_{2,\,2} + T_{3,\,2} + T_{1,\,2} + T_{2,\,3} + 10 = 0$$
$$-4\,T_{3,\,2} + T_{4,\,2} + T_{2,\,2} + T_{3,\,3} + 10 = 0$$
$$-4\,T_{4,\,2} + 2\,T_{3,\,2} + T_{4,\,3} + 10 = 0$$
$$-4\,T_{1,\,3} + 2\,T_{2,\,3} + 30 + T_{1,\,2} = 0$$
$$-4\,T_{2,\,3} + T_{3,\,3} + T_{1,\,3} + 30 + T_{2,\,2} = 0$$
$$-4\,T_{3,\,3} + T_{4,\,3} + T_{2,\,3} + 30 + T_{3,\,2} = 0$$
$$-4\,T_{4,\,3} + 2\,T_{3,\,3} + 30 + T_{4,\,2} = 0 \tag{1.9}$$

> N := k − 1;

$$N := 8 \tag{1.10}$$

> Eqs := {seq(Eq[k], k = 1 ..N)};

$$Eqs := \{-4\,T_{1,\,2} + 2\,T_{2,\,2} + T_{1,\,3} + 10 = 0,\ -4\,T_{1,\,3} + 2\,T_{2,\,3} + 30 + T_{1,\,2} = 0,\ -4\,T_{4,\,2} + 2\,T_{3,\,2} + T_{4,\,3} + 10 = 0,\ -4\,T_{4,\,3} + 2\,T_{3,\,3} + 30 + T_{4,\,2} = 0,\ -4\,T_{2,\,2} + T_{3,\,2} + T_{1,\,2} + T_{2,\,3} + 10 = 0,\ -4\,T_{2,\,3} + T_{3,\,3} + T_{1,\,3} + 30 + T_{2,\,2} = 0,\ -4\,T_{3,\,2} + T_{4,\,2} + T_{2,\,2} + T_{3,\,3} + 10 = 0,\ -4\,T_{3,\,3} + T_{4,\,3} + T_{2,\,3} + 30 + T_{3,\,2} = 0\} \tag{1.11}$$

> Tmps := [seq(Temps[k], k = 1 ..N)];

$$Tmps := [T_{1,\,2}, T_{2,\,2}, T_{3,\,2}, T_{4,\,2}, T_{1,\,3}, T_{2,\,3}, T_{3,\,3}, T_{4,\,3}] \tag{1.12}$$

> SolT := solve(Eqs, Tmps);

$$SolT := \left[\left[T_{1,\,2} = \frac{50}{3}, T_{2,\,2} = \frac{50}{3}, T_{3,\,2} = \frac{50}{3}, T_{4,\,2} = \frac{50}{3}, T_{1,\,3} = \frac{70}{3}, T_{2,\,3} = \frac{70}{3}, T_{3,\,3} = \frac{70}{3}, T_{4,\,3} = \frac{70}{3}\right]\right] \tag{1.13}$$

```
> Eqs := [seq(Eq[k], k = 1 .. N)];
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$$Eqs := [-4\,T_{1,2} + 2\,T_{2,2} + T_{1,3} + 10 = 0,\ -4\,T_{2,2} + T_{3,2} + T_{1,2} + T_{2,3} + 10 = 0,\ -4\,T_{3,2} + T_{4,2} + T_{2,2} + T_{3,3} + 10 = 0,\ -4\,T_{4,2} + 2\,T_{3,2} + T_{4,3} + 10 = 0,\ -4\,T_{1,3} + 2\,T_{2,3} + 30 + T_{1,2} = 0,\ -4\,T_{2,3} + T_{3,3} + T_{1,3} + 30 + T_{2,2} = 0,\ -4\,T_{3,3} + T_{4,3} + T_{2,3} + 30 + T_{3,2} = 0,\ -4\,T_{4,3} + 2\,T_{3,3} + 30 + T_{4,2} = 0] \tag{1.14}$$

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> M, R := GenerateMatrix(Eqs, Tmps)
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$$M, R := \begin{bmatrix} -4 & 2 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & -4 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & -4 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 2 & -4 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & -4 & 2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & -4 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & -4 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 2 & -4 \end{bmatrix}, \begin{bmatrix} -10 \\ -10 \\ -10 \\ -10 \\ -30 \\ -30 \\ -30 \\ -30 \end{bmatrix} \tag{1.15}$$