

If the model of a system having thermocouples measuring temperatures, T (°C), at its different points is given by the set of expressions in Equation (1), estimate the values of temperatures using:

Gauss elimination method manually

(2) Microsoft Excel

(3) MATLAB

(4) Matrix Inverse method on Matlab and Excel.

$$\left\{ \begin{array}{l} T_1 + T_2 - 2T_3 + T_4 + 3T_5 - T_6 = 4 \\ 2T_1 - T_2 + T_3 + 2T_4 + T_5 - 3T_6 = 20 \\ T_1 + 3T_2 - 3T_3 - 3T_4 - T_5 + 2T_6 = -15 \\ 5T_1 + 2T_2 - T_3 - T_4 + 2T_5 + T_6 = -3 \\ -3T_1 - T_2 + 2T_3 + 3T_4 + T_5 + 3T_6 = 16 \\ 4T_1 + 3T_2 + T_3 - 6T_4 - 3T_5 - 2T_6 = -27 \end{array} \right.$$

+ (28-0-12-0-0) * x = 50000 - Solution.

$$\begin{array}{rcl} +T_1 & +T_2 & -2T_3 + T_4 + 3T_5 - T_6 = 4 \\ 2T_1 & -T_2 & +T_3 + 2T_4 + T_5 - 3T_6 = 20 \\ T_1 & +3T_2 & -3T_3 - 3T_4 - T_5 + 2T_6 = -15 \\ 5T_1 & +2T_2 & -T_3 - T_4 + 2T_5 + T_6 = -3 \\ -3T_1 & -T_2 & +2T_3 + 3T_4 + T_5 + 3T_6 = 16 \\ 4T_1 & +3T_2 & +T_3 - 6T_4 - 3T_5 - 2T_6 = -27 \end{array}$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 2 & -1 & 1 & 2 & 1 & -3 \\ 1 & 3 & -3 & -1 & 2 & 1 \\ 5 & 2 & -1 & -1 & 2 & 1 \\ -3 & -1 & 2 & 3 & 1 & 1 \\ 4 & 3 & 1 & -6 & -3 & -2 \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \\ T_6 \end{bmatrix} = \begin{bmatrix} 4 \\ 20 \\ -15 \\ -3 \\ 16 \\ -27 \end{bmatrix}$$

make 2, -1, 3, 5, 2, -3, -1, -1, 2, 3, 4, 3, 1, -6, -3 $\Rightarrow 0$

Solution column 1

Factor = 2

$$2 - (1 \times 2), -1 - (1 \times 2), 1 - (-2 \times 2), 2(1 \times 2), 1 - (3 \times 2), -3 - (-1 \times 2)$$

$$= 0, -3, 5, 0, -5, -1$$

Factor = 1

$$1 - (1 \times 1), 3 - (1 \times 1), -3 - (-2 \times 1), -1 - (1 \times 1), 2 - (3 \times 1), -1 - (-1 \times 1)$$

$$= 0, 2, -1, -2, -1, 2$$

Factor = 5

$$5 - (1 \times 5), 2 - (1 \times 5), -1 - (-2 \times 5), -1 - (1 \times 5), 2 - (3 \times 5), 1 - (-1 \times 5)$$

$$= 0, -3, 9, -6, -13, 6$$

Factor = -3

$$-3 - (1 \times -3), -1 - (1 \times -3), 2 - (-2 \times -3), 3 - (1 \times -3), 1 - (3 \times -3), 1 - (-1 \times -3)$$

$$= 0, 2, -4, 6, 10, -2$$

Factor = 4

$$4 - (1 \times 4), 3 - (1 \times 4), 1 - (-2 \times 4), -6 - (1 \times 4), -3 - (3 \times 4), -1 - 2 - (-1 \times 4)$$

$$= 0, -1, 9, -10, -15, 2$$

column 2

pivot row = 2

$$1 - (2 \times \frac{1}{3}) \rightarrow \text{factor}, 3 - (-1 \times \frac{1}{3}), -3 - (1 \times \frac{1}{3}), -1 - (2 \times \frac{1}{3})$$

$$2 - (1 \times \frac{1}{3}), 1 - (3 \times \frac{1}{3})$$

$$= 7, 0, 0, +5, 5, 10$$

$$5 - (2 \times -2), 2 - (-1 \times -2), -1 - (1 \times -2), -1 - (2 \times -2), 2 - (1 \times -2)$$

$$= 9, 0, 1, 3, 4, -5$$

$$-3 - (1 \times 2), -1 - (-1 \times 1), 2 - (1 \times 1), 3 - (1 \times 2)$$

$$-5, 0, 1, 1, 1, 4$$

$$4 - (-3 \times 2), 3 - (-1 \times -3), 1 - (1 \times -3), -6 - (2 \times -3)$$

$$= 10, 0, 4, 0, 0, -11$$

Pivot row (3rd row)

$$5 - (1 \times \frac{1}{3}), 2 - (3 \times \frac{1}{3}), -1 - (-3 \times \frac{1}{3}), -1 - (2 \times \frac{1}{3})$$

$$2 - (1 \times \frac{1}{3}), 1 - (\frac{1}{3} \times -3)$$

$$= 4.667, 1, 0, -1.667, -1.667, 2$$

$$-3 - (2 \times \frac{2}{3}), -1 - (3 \times \frac{2}{3}), 2 - (-3 \times \frac{2}{3}), 3 - (-1 \times \frac{2}{3})$$

$$1 - (1 \times \frac{2}{3}), -1 - (3 \times \frac{2}{3})$$

$$-1.667, 1, 0, 2.333, 1.667, -1$$

$$4 - (2 \times 1), 3 - (-1 \times 1), 1 - (1 \times 1), -6 - (2 \times 1)$$

$$-3 - (1 \times 1), -2 - (-3 \times 1)$$

$$= 2, 4, 0, -8, -4, 1$$

PIVOT ROW (4th row)

$$-3 - (5x-3), -1 - (2x-3), 2 - (-1x-3), 3 - (-1x-3)$$

$$1 - (2x-3), 1 - (1x-3)$$

$$12, 5, -1, 0, 7, 4$$

$$4 - (5 \times 6), 3 - (2 \times 6), 1 - (-1 \times 6), -6 - (-1 \times 6)$$

$$-3 - (2 \times 6), -2 - (1 \times 6)$$

$$-27, -9, 7, 0, -15, -8,$$

PIVOT ROW (5th row).

$$4 - (-3x-3), 3 - (-1x-3), 1 - (2x-3), -6 - (3x-3)$$

$$-3 - (1x-3), -2 - (1x-3)$$

$$= -5, 0, 7, 3, 0, 1$$

$$\left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & 1 & T_1 \\ 0 & -3 & 5 & 0 & -5 & 1 & T_2 \\ 0 & 2 & -1 & -2 & -1 & 2 & T_3 \\ 0 & -3 & 9 & -6 & -13 & 6 & T_4 \\ 0 & 2 & -4 & 6 & 10 & -2 & T_5 \\ 0 & -1 & 9 & -10 & -15 & 2 & T_6 \end{array} \right]$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 2 & -1 & -2 & -1 & 2 \\ 0 & -3 & 9 & -6 & -13 & 6 \\ 0 & 2 & -4 & 6 & 10 & -2 \\ 0 & -1 & 9 & -10 & -15 & 2 \end{bmatrix}$$

$$\text{factor} = -\frac{2}{3}$$

$$0 - \left(0 \times -\frac{2}{3}\right), \quad 2 - \left(-3 \times -\frac{2}{3}\right), \quad -1 - \left(5 \times -\frac{2}{3}\right), \quad -2 - \left(0 \times -\frac{2}{3}\right), \\ -1 - \left(-5 \times -\frac{2}{3}\right), \quad 2 - \left(-1 \times -\frac{2}{3}\right)$$

$$= 0, \quad 0, \quad 2.333, \quad -2, \quad -4.333, \quad 1.333$$

$$\text{factor} = 1$$

$$0 - (0 - 1), \quad -3 - (-3 \times 1), \quad 9 - (1 \times 5), \quad -6 - (0 \times 1), \\ -13 - (1 \times -5), \quad 6 - (-1 \times 1)$$

$$0, \quad 0, \quad 4, \quad -6, \quad -8, \quad 7$$

$$\text{factor} = -\frac{2}{3}$$

$$0 - \left(0 \times -\frac{2}{3}\right), \quad 2 - \left(-3 \times -\frac{2}{3}\right), \quad -4 - \left(5 \times -\frac{2}{3}\right), \quad 6 - \left(0 \times -\frac{2}{3}\right), \\ 10 - \left(-5 \times -\frac{2}{3}\right), \quad -2 - \left(-1 \times -\frac{2}{3}\right)$$

$$0, \quad 0, \quad -0.667, \quad 6, \quad 6.667, \quad -2.667$$

$$\text{Factor} = -\frac{1}{3}$$

$$0 - (0 \times \frac{1}{3}), -1 - (-3 \times \frac{1}{3}), 9 - (5 \times \frac{1}{3}), -10 - (0 \times \frac{1}{3})$$

$$-15 - (-5 \times \frac{1}{3}), 2 - (-1 \times \frac{1}{3})$$

$$= 0, 0, 7.333, -10, -13.333, 2.333$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.33 & -2 & -4.33 & 1.33 \\ 0 & 0 & 4 & -6 & -8 & 7 \\ 0 & 0 & -0.667 & 6 & 6.667 & -2.667 \\ 0 & 0 & 7.333 & -10 & -13.333 & 2.333 \end{bmatrix}$$

Pivot Row - 3rd Row

$$0 \quad 0 \quad 2.33 \quad -2 \quad -4.33 \quad 1.33$$

$$0 - (0 \times \frac{4}{2.33}), 0 - (0 \times \frac{4}{2.33}), 4 - (2.33 \times \frac{4}{2.33})$$

$$6 - (-2 \times \frac{4}{2.33}), -8 - (-4.33 \times \frac{4}{2.33}), 7 - (1.33 \times \frac{4}{2.33})$$

$$= 0, 0, 0, -2.5665, -0.5665, 4.7167$$

$$0 - (0 \times \frac{-0.667}{2.33}), 0 - (0 \times \frac{-0.667}{2.33}), -0.667 - (2.33 \times \frac{-0.667}{2.33})$$

$$6 - (-2 \times \frac{-0.667}{2.33}), 6.667 - (-4.33 \times \frac{-0.667}{2.33}), -2.667 - (1.33 \times \frac{-0.667}{2.33})$$

$$0, 0, 0, 5.428, 5.428, -0.2857$$

$$0 - \left(0 \times \frac{7.33}{2.33} \right), 0 - \left(0 \times \left(\frac{7.33}{2.33} \right) \right), 7.33 - \left(\frac{2.33 \times 7.33}{2.33} \right)$$

$$-10 - \left(\frac{-2 \times 7.33}{2.33} \right), -13.33 - \left(\frac{-4.33 \times 7.33}{2.33} \right),$$

$$2.33 - \left(\frac{1.33 \times 7.33}{2.33} \right)$$

$$0, 0, 0, -3.7082, 0.2918, -1.8541$$

1	1	-2	1	3	-1
0	-3	5	0	-5	-1
0	0	2.333	-2	-4.333	1.333
0	0	0	-2.57143	-0.57143	4.714286
0	0	0	5.42871	5.42871	-0.28571
0	0	0	6.57143	7.714286	2.28571
0	0	0	-3.7082	0.2918	-1.8541

$$0 \quad 0 \quad 0 \quad -2.57143 \quad -0.57143 \quad 4.714286$$

$$0 - \left(0 \times \frac{5.42871}{-2.57143} \right), 0 - \left(0 \times \frac{5.42871}{-2.57143} \right), 0 - \left(0 \times \frac{5.42871}{-2.57143} \right)$$

$$5.42871 - \left(\frac{-2.57143 \times 5.42871}{-2.57143} \right),$$

$$5.42871 - \left(\frac{-0.57143 \times 5.42871}{-2.57143} \right),$$

$$-0.28571 - \left(\frac{4.714286 \times 5.42871}{-2.57143} \right)$$

$$= 0, 0, 0, 0, 4.219, 5.42871$$

$$0 - \left(0 \times \frac{-5.42871}{-2.57143} \right), 0 - \left(0 \times \frac{-5.42871}{-2.57143} \right),$$

$$0 - \left(0 \times \frac{-5.42871}{-2.57143} \right), -3.7082 - \left(\frac{-2.57143 \times -3.7082}{-2.57143} \right),$$

$$0.2918 - \left(\frac{-0.57143 \times -3.7082}{-2.57143} \right), -1.8541 - \left(\frac{4.714286 \times -3.7082}{-2.57143} \right)$$

$$\begin{array}{r|rrrrr}
 1 & 1 & -2 & 2 & 3 & -1 \\
 0 & -3 & 5 & 0 & -5 & -1 \\
 0 & 0 & 2.333 & -2 & -4.333 & 1.333 \\
 0 & 0 & 0 & -2.57143 & -0.57143 & 4.714286 \\
 0 & 0 & 0 & 5.42871 & 5.42871 & -0.28571 \\
 0 & 0 & 0 & ~~6.57143~~ & ~~7.714286~~ & ~~2.28571~~ \\
 0 & 0 & 0 & -3.7082 & 0.2918 & -1.8541
 \end{array}$$

$$0 \quad 0 \quad 0 \quad -2.57143 \quad -0.57143 \quad 4.714286$$

$$0 = (0 \times \frac{5.42871}{-2.57143}), \quad 0 = (0 \times \frac{5.42871}{-2.57143}), \quad 0 = (0 \times \frac{5.42871}{-2.57143})$$

$$5.42871 - \left(\frac{-2.57143 \times 5.42871}{-2.57143} \right)$$

$$5.42871 - \left(\frac{-0.57143 \times 5.42871}{-2.57143} \right)$$

$$= 0, \quad 0, \quad 0, \quad 0, \quad 4.219, \quad \frac{4.7143 \times 5.42871}{-2.57143}$$

$$0 = (0 \times \frac{-3.7082}{-2.57143}), \quad 0 = (0 \times \frac{-3.7082}{-2.57143})$$

$$0 = (0 \times \frac{-5.42871}{-2.57143}), \quad -3.7082 - \left(\frac{-2.57143 \times -3.7082}{-2.57143} \right)$$

$$0.2918 - \left(\frac{-0.57143 \times 3.7082}{-2.57143} \right), \quad -1.8541 \left(\frac{-4.714286 \times 3.7082}{-2.57143} \right)$$

$$0, 0, 0, 0, 1.1158, -8.666$$

$$\begin{bmatrix} 1 & 1 & -2 & 1 & 3 & 1 \\ 0 & -3 & 5 & 0 & -5 & -1 \\ 0 & 0 & 2.333 & -2.333 & 1.333 & -4.333 \\ 0 & 0 & 0 & -2.57143 & 4.71428 & -0.57143 \\ 0 & 0 & 0 & 0 & 4.219 & 9.669 \\ 0 & 0 & 0 & 0 & 1.1158 & -8.666 \end{bmatrix}$$

→ PIVOT ROW

$$0 \quad 0 \quad 0 \quad 0 \quad 4.219 \quad 9.669$$

$$\text{factor} = \left(\frac{1.1158}{4.219} \right)$$

$$0 - \left(0 * \left(\frac{1.1158}{4.219} \right) \right), \quad 0 - \left(0 * \left(\frac{1.1158}{4.219} \right) \right), \quad 0 - \left(0 * \left(\frac{1.1158}{4.219} \right) \right),$$

$$0 - \left(0 * \left(\frac{1.1158}{4.219} \right) \right), \quad 1.1158 - \left(\frac{4.219 * 1.1158}{4.219} \right), \\ -8.666 - \left(\frac{9.669 * 1.1158}{4.219} \right)$$

$$0, 0, 0, 0, 0, -11.223?$$