

Chapter 04.06

Gaussian Elimination – More Examples

Electrical Engineering

Example 1

Three-phase loads are common in AC systems. When the system is balanced the analysis can be simplified to a single equivalent circuit model. However, when it is unbalanced the only practical solution involves the solution of simultaneous linear equations. In one model the following equations need to be solved.

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0.4516 & 0.7460 & 0.0080 & 0.0100 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.7787 & -0.5205 & 0.0100 & -0.0080 \\ 0.0080 & 0.0100 & 0.5205 & 0.7787 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.0100 & -0.0080 & 0.8080 & -0.6040 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ 0.000 \\ -60.00 \\ -103.9 \\ -60.00 \\ 103.9 \end{bmatrix}$$

Find the values of I_{ar} , I_{ai} , I_{br} , I_{bi} , I_{cr} , and I_{ci} using naïve Gauss elimination.

Solution

Forward Elimination of Unknowns

Since there are six equations, there will be five steps of forward elimination of unknowns.

First step

Divide Row 1 by 0.7460 and multiply it by 0.4516, that is, multiply Row 1 by $0.4516/0.7460 = 0.60536$.

Row 1 $\times (0.60536) =$

$$[0.4516 \quad -0.27338 \quad 0.0060536 \quad -0.0048429 \quad 0.0060536 \quad -0.0048429] \quad [72.643]$$

Subtract the result from Row 2 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0.0100 & -0.0080 & 0.7787 & -0.5205 & 0.0100 & -0.0080 \\ 0.0080 & 0.0100 & 0.5205 & 0.7787 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.0100 & -0.0080 & 0.8080 & -0.6040 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -60.00 \\ -103.9 \\ -60.00 \\ 103.9 \end{bmatrix}$$

Divide Row 1 by 0.7460 and multiply it by 0.0100, that is, multiply Row 1 by $0.0100/0.7460 = 0.013405$.

Row 1 \times (0.013405) =

$$\begin{bmatrix} 0.0100 & -0.0060536 & 0.00013405 & -0.00010724 & 0.00013405 & -0.00010724 \end{bmatrix} \quad [1.6086]$$

Subtract the result from Row 3 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & -0.0019464 & 0.77857 & -0.52061 & 0.0098660 & -0.0078928 \\ 0.0080 & 0.0100 & 0.5205 & 0.7787 & 0.0080 & 0.0100 \\ 0.0100 & -0.0080 & 0.0100 & -0.0080 & 0.8080 & -0.6040 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.609 \\ -103.9 \\ -60.00 \\ 103.9 \end{bmatrix}$$

Divide Row 1 by 0.7460 and multiply it by 0.0080, that is, multiply Row 1 by $0.0080/0.7460 = 0.010724$.

Row 1 \times (0.010724) =

$$\begin{bmatrix} 0.0080 & -0.0048429 & 0.00010724 & -8.5791 \times 10^{-5} & 0.00010724 & -8.5791 \times 10^{-5} \end{bmatrix} \quad [1.2869]$$

Subtract the result from Row 4 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & -0.0019464 & 0.77857 & -0.52061 & 0.0098660 & -0.0078928 \\ 0 & 0.014843 & 0.52039 & 0.77879 & 0.0078928 & 0.010086 \\ 0.0100 & -0.0080 & 0.0100 & -0.0080 & 0.8080 & -0.6040 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.609 \\ -105.19 \\ -60.00 \\ 103.9 \end{bmatrix}$$

Divide Row 1 by 0.7460 and multiply it by 0.0100, that is, multiply Row 1 by $0.0100/0.7460 = 0.013405$.

Row 1 \times (0.013405) =

$$\begin{bmatrix} 0.0100 & -0.0060536 & 0.00013405 & -0.00010724 & 0.00013405 & -0.00010724 \end{bmatrix} \quad [1.6086]$$

Subtract the result from Row 5 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & -0.0019464 & 0.77857 & -0.52061 & 0.0098660 & -0.0078928 \\ 0 & 0.014843 & 0.52039 & 0.77879 & 0.0078928 & 0.010086 \\ 0 & -0.0019464 & 0.0098660 & -0.0078928 & 0.80787 & -0.60389 \\ 0.0080 & 0.0100 & 0.0080 & 0.0100 & 0.6040 & 0.8080 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.609 \\ -105.19 \\ -61.609 \\ 103.9 \end{bmatrix}$$

Divide Row 1 by 0.7460 and multiply it by 0.0080, that is, multiply Row 1 by $0.0080/0.7460 = 0.010724$.

Row 1 \times (0.010724) =

$$\begin{bmatrix} 0.0080 & -0.0048429 & 0.00010724 & -8.5791 \times 10^{-5} & 0.00010724 & -8.5791 \times 10^{-5} \end{bmatrix} \quad [1.2869]$$

Subtract the result from Row 6 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & -0.0019464 & 0.77857 & -0.52039 & 0.0098660 & -0.0078928 \\ 0 & 0.014843 & 0.52039 & 0.77879 & 0.0078928 & 0.010086 \\ 0 & -0.0019464 & 0.0098660 & -0.0078928 & 0.80787 & -0.60389 \\ 0 & 0.014843 & 0.0078928 & 0.010086 & 0.60389 & 0.80809 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.609 \\ -105.19 \\ -61.609 \\ 102.61 \end{bmatrix}$$

Second step

Divide Row 2 by 1.0194 and multiply it by -0.0019464 , that is, multiply Row 2 by $-0.0019464/1.0194 = -0.0019094$.

Row 2 \times (-0.0019094) =

$$\begin{bmatrix} 0 & -0.0019464 & -3.7164 \times 10^{-6} & -2.8341 \times 10^{-5} & -3.7164 \times 10^{-6} & -2.8341 \times 10^{-5} \end{bmatrix} \quad [0.13870]$$

Subtract the result from Row 3 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0.014843 & 0.52039 & 0.77879 & 0.0078928 & 0.010086 \\ 0 & -0.0019464 & 0.0098660 & -0.0078928 & 0.80787 & -0.60389 \\ 0 & 0.014843 & 0.0078928 & 0.010086 & 0.60389 & 0.80809 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -105.19 \\ -61.609 \\ 102.61 \end{bmatrix}$$

Divide Row 2 by 1.0194 and multiply it by 0.014843, that is, multiply Row 2 by $0.014843/1.0194 = 0.014561$.

Row 2 \times (0.014561) =

$$\begin{bmatrix} 0 & 0.014843 & 2.8341 \times 10^{-5} & 0.00021612 & 2.8341 \times 10^{-5} & 0.00021612 \end{bmatrix} \quad [-1.0577]$$

Subtract the result from Row 4 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0.52036 & 0.77857 & 0.0078644 & 0.0098697 \\ 0 & -0.0019464 & 0.0098660 & -0.0078928 & 0.80787 & -0.60389 \\ 0 & 0.014843 & 0.0078928 & 0.010086 & 0.60389 & 0.80809 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -104.13 \\ -61.609 \\ 102.61 \end{bmatrix}$$

Divide Row 2 by 1.0194 and multiply it by -0.0019464 , that is, multiply Row 2 by $-0.0019464/1.0194 = -0.0019094$.

Row 2 $\times (-0.0019094) =$

$$\left[0 \quad -0.0019464 \quad -3.7164 \times 10^{-6} \quad -2.8341 \times 10^{-5} \quad -3.7164 \times 10^{-6} \quad -2.8341 \times 10^{-5} \right] \quad [0.13870]$$

Subtract the result from Row 5 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0.52036 & 0.77857 & 0.0078644 & 0.0098697 \\ 0 & 0 & 0.0098697 & -0.0078644 & 0.80787 & -0.60386 \\ 0 & 0.014843 & 0.0078928 & 0.010086 & 0.60389 & 0.80809 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -104.13 \\ -61.747 \\ 102.61 \end{bmatrix}$$

Divide Row 2 by 1.0194 and multiply it by 0.014843, that is, multiply Row 2 by $0.014843/1.0194 = 0.014561$.

Row 2 $\times (0.014561) =$

$$\left[0 \quad 0.014843 \quad 2.8341 \times 10^{-5} \quad 0.00021612 \quad 2.8341 \times 10^{-5} \quad 0.00021612 \right] \quad [-1.0577]$$

Subtract the result from Row 6 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0.52036 & 0.77857 & 0.0078644 & 0.0098697 \\ 0 & 0 & 0.0098697 & -0.0078644 & 0.80787 & -0.60386 \\ 0 & 0 & 0.0078644 & 0.0098697 & 0.60386 & 0.80787 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -104.13 \\ -61.747 \\ 103.67 \end{bmatrix}$$

Third step

Divide Row 3 by 0.77857 and multiply it by 0.52036, that is, multiply Row 3 by $0.52036/0.77857 = 0.66836$.

Row 3 $\times (0.66836) =$

$$\left[0 \quad 0 \quad 0.52036 \quad -0.34779 \quad 0.0065965 \quad -0.0052563 \right] \quad [-41.269]$$

Subtract the result from Row 4 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0.0098697 & -0.0078644 & 0.80787 & -0.60386 \\ 0 & 0 & 0.0078644 & 0.0098697 & 0.60386 & 0.80787 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -61.747 \\ 103.67 \end{bmatrix}$$

Divide Row 3 by 0.77857 and multiply it by 0.0098697, that is, multiply Row 3 by $0.0098697/0.77857 = 0.012677$.

Row 3 \times (0.012677) =

$$\left[0 \quad 0 \quad 0.0098697 \quad -0.0065965 \quad 0.00012511 \quad -9.9695 \times 10^{-5} \right] \quad \left[-0.78275 \right]$$

Subtract the result from Row 5 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0 & -0.0012679 & 0.80774 & -0.60376 \\ 0 & 0 & 0.0078644 & 0.0098697 & 0.60386 & 0.80787 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -60.965 \\ 103.67 \end{bmatrix}$$

Divide Row 3 by 0.77857 and multiply it by 0.0078644, that is, multiply Row 3 by $0.0078644/0.77857 = 0.010101$.

Row 3 \times (0.010101) =

$$\left[0 \quad 0 \quad 0.0078644 \quad -0.0052563 \quad 9.9695 \times 10^{-5} \quad -7.9439 \times 10^{-5} \right] \quad \left[-0.62372 \right]$$

Subtract the result from Row 6 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0 & -0.0012679 & 0.80774 & -0.60376 \\ 0 & 0 & 0 & 0.015126 & 0.60376 & 0.80795 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -60.965 \\ 104.29 \end{bmatrix}$$

Fourth step

Divide Row 4 by 1.1264 and multiply it by -0.0012679 , that is, multiply Row 4 by $-0.0012679/1.1264 = -0.0011257$.

Row 4 \times (-0.0011257) =

$$\left[0 \quad 0 \quad 0 \quad -0.0012679 \quad -1.4273 \times 10^{-6} \quad -1.7027 \times 10^{-5} \right] \quad \left[0.070761 \right]$$

Subtract the result from Row 5 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0 & 0 & 0.80775 & -0.60375 \\ 0 & 0 & 0 & 0.015126 & 0.60376 & 0.80795 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -61.035 \\ 104.29 \end{bmatrix}$$

Divide Row 4 by 1.1264 and multiply it by 0.015126, that is, multiply Row 4 by $0.015126/1.1264 = 0.013429$.

Row 4 \times (0.013429) =

$$\begin{bmatrix} 0 & 0 & 0 & 0.015126 & 1.7027 \times 10^{-5} & 0.00020313 \end{bmatrix} \quad [-0.84415]$$

Subtract the result from Row 6 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0 & 0 & 0.80775 & -0.60375 \\ 0 & 0 & 0 & 0 & 0.60375 & 0.80775 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -61.035 \\ 105.13 \end{bmatrix}$$

Fifth step

Divide Row 5 by 0.80775 and multiply it by 0.60375, that is, multiply Row 5 by $0.60375/0.80775 = 0.74745$.

Row 5 \times (0.74741) =

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0.60375 & -0.45127 \end{bmatrix} \quad [-45.621]$$

Subtract the result from Row 6 to get

$$\begin{bmatrix} 0.7460 & -0.4516 & 0.0100 & -0.0080 & 0.0100 & -0.0080 \\ 0 & 1.0194 & 0.0019464 & 0.014843 & 0.0019464 & 0.014843 \\ 0 & 0 & 0.77857 & -0.52036 & 0.0098697 & -0.0078644 \\ 0 & 0 & 0 & 1.1264 & 0.0012679 & 0.015126 \\ 0 & 0 & 0 & 0 & 0.80775 & -0.60375 \\ 0 & 0 & 0 & 0 & 0 & 1.2590 \end{bmatrix} \begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 120 \\ -72.643 \\ -61.747 \\ -62.860 \\ -61.035 \\ 150.75 \end{bmatrix}$$

The six equations are

$$0.7460 I_{ar} + (-0.4516) I_{ai} + 0.0100 I_{br} + (-0.0080) I_{bi} + 0.0100 I_{cr} + (-0.0080) I_{ci} = 120$$

$$1.0194 I_{ai} + 0.0019464 I_{br} + 0.014843 I_{bi} + 0.0019464 I_{cr} + 0.014843 I_{ci} = -72.643$$

$$0.77857 I_{br} - 0.52036 I_{bi} + 0.0098697 I_{cr} + (-0.0078644) I_{ci} = -61.747$$

$$1.1264 I_{bi} + 0.0012679 I_{cr} + 0.015126 I_{ci} = -62.860$$

$$0.80775 I_{cr} + (-0.60375) I_{ci} = -61.035$$

$$1.2590 I_{ci} = 150.75$$

Back Substitution

From the sixth equation

$$1.2590 I_{ci} = 150.75$$

$$\begin{aligned} I_{ci} &= \frac{150.75}{1.2590} \\ &= 119.74 \end{aligned}$$

Substituting the value of I_{ci} in the fifth equation,

$$0.80775 I_{cr} + (-0.60375) I_{ci} = -61.035$$

$$I_{cr} = \frac{-61.035 - (-0.60375)I_{ci}}{0.80775}$$

$$= 13.938$$

Substituting the value of I_{cr} and I_{ci} in the fourth equation,

$$1.1264I_{bi} + 0.0012679I_{cr} + 0.015126I_{ci} = -62.860$$

$$I_{bi} = \frac{-62.860 - 0.0012679I_{cr} - 0.015126I_{ci}}{1.1264}$$

$$= -57.429$$

Substituting the value of I_{bi} , I_{cr} and I_{ci} in the third equation,

$$0.77857I_{br} - 0.52036I_{bi} + 0.0098697I_{cr} + (-0.0078644)I_{ci} = -61.747$$

$$I_{br} = \frac{-61.747 + 0.52036I_{bi} - 0.0098697I_{cr} - (-0.0078644)I_{ci}}{0.77857}$$

$$= -116.66$$

Substituting the value of I_{br} , I_{bi} , I_{cr} and I_{ci} in the second equation,

$$1.0194I_{ai} + 0.0019464I_{br} + 0.014843I_{bi} + 0.0019464I_{cr} + 0.014843I_{ci} = -72.643$$

$$I_{ai} = \frac{-72.643 - 0.0019464I_{br} - 0.014843I_{bi} - 0.0019464I_{cr} - 0.014843I_{ci}}{1.0194}$$

$$= -71.972$$

Substituting the value of I_{ai} , I_{br} , I_{bi} , I_{cr} , and I_{ci} in the first equation,

$$0.7460I_{ar} + (-0.4516)I_{ai} + 0.0100I_{br} + (-0.0080)I_{bi} + 0.0100I_{cr} + (-0.0080)I_{ci} = 120$$

$$I_{ar} = \frac{120 - (-0.4516)I_{ai} - 0.0100I_{br} - (-0.0080)I_{bi} - 0.0100I_{cr} - (-0.0080)I_{ci}}{0.7460}$$

$$= 119.33$$

Hence the solution vector is

$$\begin{bmatrix} I_{ar} \\ I_{ai} \\ I_{br} \\ I_{bi} \\ I_{cr} \\ I_{ci} \end{bmatrix} = \begin{bmatrix} 119.33 \\ -71.972 \\ -116.66 \\ -57.429 \\ 13.938 \\ 119.74 \end{bmatrix}$$

SIMULTANEOUS LINEAR EQUATIONS

Topic Gaussian Elimination – More Examples

Summary Examples of Gaussian elimination

Major Electrical Engineering

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Web Site <http://numericalmethods.eng.usf.edu>
