GENG-8030 Computational Methods and Modeling for Engineering Applications

Summer 2023

Tutorial 7

All questions were taken from the course textbook:

Title	MATLAB for engineering applications
Author	William J. Palm
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Chapter 8: Linear Algebraic Equations

2.* *a.* Solve the following matrix equation for the matrix **C**.

$$\mathbf{A}(\mathbf{BC} + \mathbf{A}) = \mathbf{B}$$

b. Evaluate the solution obtained in part *a* for the case

$$\mathbf{A} = \begin{bmatrix} 7 & 9 \\ -2 & 4 \end{bmatrix} \qquad \mathbf{B} = \begin{bmatrix} 4 & -3 \\ 7 & 6 \end{bmatrix}$$

5.* *a.* Use MATLAB to solve the following equations for x, y, and z as functions of the parameter c.

$$\begin{aligned} x - 5y - 2z &= 11c \\ 6x + 3y + z &= 13c \\ 7x + 3y - 5z &= 10c \end{aligned}$$

b. Plot the solutions for x, y, and z versus c on the same plot, for $-10 \le c \le 10$.

12. A weight W is supported by two cables anchored a distance D apart (see Figure P12). The cable length L_{AB} is given, but the length L_{AC} is to be selected. Each cable can support a maximum tension force equal to W. For the weight to remain stationary, the total horizontal force and total vertical force must each be zero. This principle gives the equations

$$-T_{AB}\cos\theta + T_{AC}\cos\phi = 0$$
$$T_{AB}\sin\theta + T_{AC}\sin\phi = W$$

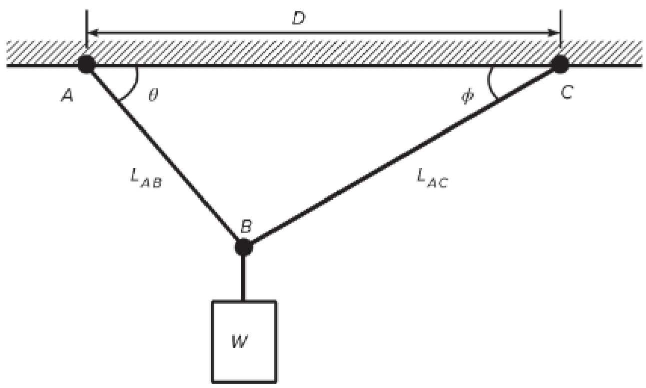

Figure P12

We can solve these equations for the tension forces T_{AB} and T_{AC} if we know the angles θ and ϕ. From the law of cosines

$$\theta = \cos^{-1}\left(\frac{D^2 + L_{AB}^2 - L_{AC}^2}{2DL_{AB}}\right)$$

From the law of sines

$$\phi = \sin^{-1}\left(\frac{L_{AB}\sin\theta}{L_{AC}}\right)$$

For the given values $D = 6$ ft, $L_{AB} = 3$ ft, and $W = 2000$ lb, use a loop in MATLAB to find $L_{AC\min}$, the shortest length L_{AC} we can use without T_{AB} or T_{AC} exceeding 2000 lb. Note that the largest L_{AC} can be is 6.7 ft (which corresponds to $\theta = 90°$). Plot the tension forces T_{AB} and T_{AC} on the same graph versus L_{AC} for $L_{AC\min} \le L_{AC} \le 6.7$.

14. Solve the following equations:

$$\begin{aligned} 6x - 4y + 3z &= 10 \\ 4x + 3y - 2z &= 46 \\ 10x - y + z &= 56 \end{aligned}$$

16. See **Figure P16**. Assume that no vehicles stop within the network. A traffic engineer wants to know if the traffic flows $f_1, f_2, \ldots, f_7$ (in vehicles per hour) can be computed given the measured flows shown in the figure. If not, then determine how many more traffic sensors need to be installed, and obtain the expressions for the other traffic flows in terms of the measured quantities.

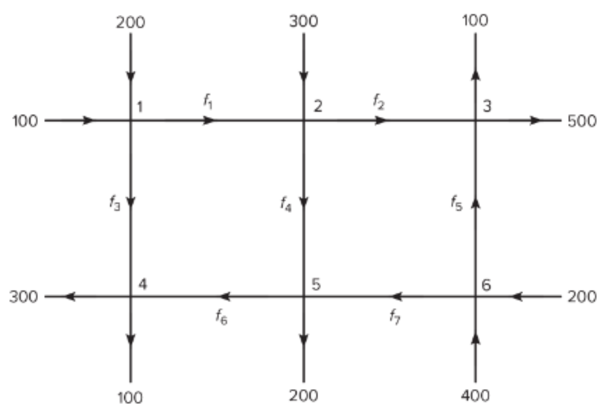

Figure P16

17. Use MATLAB to find the coefficients of the cubic polynomial $ax^3 + bx^2cx + d$ that passes through the four points $(x, y) = (1, 12), (2, 76), (4, 620), (5, 1160)$.

19. Use MATLAB to solve the following problem:

$$\begin{aligned} x + 6y &= 64 \\ 7x - 2y &= \ \ 8 \\ 2x + 3y &= 38 \end{aligned}$$

22. *a.* Use MATLAB to find the coefficients of the quadratic polynomial $y = ax^2 + bx + c$ that passes through the three points $(x, y) = (1, 4), (4, 73), (5, 120)$.

b. Use MATLAB to find the coefficients of the cubic polynomial $y = ax^3 + bx^2 + cx + d$ that passes through the three points given in part *a.*