

Lecture Module - Systems of Linear Equations

ME3001 - Mechanical Engineering Analysis

Mechanical Engineering

Tennessee Technological University

Module 3 - Systems of Linear Equations

Module 3 - Systems of Linear Equations

- Topic 1 - Linear Systems Review
- Topic 2 -
- Topic 3 -

Topic 1 - Linear Systems Review

- What is a Linear Equation ?
- General Form of A Linear System
- The Geometrical Explanation
- Examples in MATLAB

What is a Linear Equation ?

What is a Linear Equation

- “A linear equation is an algebraic equation in which each term is either a constant or the product of a constant and a single variable” - Wikipedia
- slope intercept form
- does not contain

What is a System of Linear Equations?

- multiple linear equations with...
- also known as...

General Form of A Linear System

The general system of linear equations is shown with variables $x_{1,2,...,n}$, coefficients $a_{11,12,...,nm}$, and knowns $b_{1,2,...,m}$

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$$

.

$$a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n = b_m$$

The equations are cast into matrix form of the system.

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ & . & & \\ & . & & \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ . \\ . \\ x_n \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ . \\ . \\ b_m \end{bmatrix}$$

General Form of A Linear System

To verify the matrix form $[A]\{x\} = \{b\}$ is correct, use matrix multiplication and the result will match the individual equations.

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ & \cdot & & \\ & \cdot & & \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ \cdot \\ \cdot \\ x_n \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ \cdot \\ \cdot \\ b_m \end{bmatrix}$$

The Geometrical Explanation

Consider the intersection of two Lines on the XY plane (2D).

- Write an equation for each line. $ax + by = c$
- Organize the equations.

The Geometrical Explanation

Consider the intersection of two Lines on the XY plane (2D).

- Cast the system into matrix form.
- Solve the system. What exactly does this mean?
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The Geometrical Explanation

Repeat the exercise, and now consider the intersection of three planes in space (3D). What does the solution represent?

- Write an equation for each plane. $ax + by + cz = d$
- Organize the equations.

The Geometrical Explanation

- Cast the system into matrix form.
- Solve the system. What exactly does this mean?
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Examples in MATLAB

Topic 2 -

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Topic 3 -

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Topic 3 -

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