

## Lecture Notes: Engineering Optimization

### Introduction:

- Optimization plays a crucial role in engineering design and decision-making processes.
- It involves finding the best solution among a set of possible alternatives.
- Engineering optimization aims to maximize performance, minimize costs, or achieve a balance between conflicting objectives.
- Optimization techniques help engineers make informed decisions, improve designs, and solve complex problems efficiently.

### I. Fundamentals of Optimization

#### A. Objective Function:

1. Definition: A function that measures the performance or quality of a system or design.
2. Examples: Cost function, efficiency function, reliability function.

#### B. Design Variables:

1. Parameters that define the system or design.
2. Continuous variables (e.g., dimensions, material properties) or discrete variables (e.g., selection of components).

#### C. Constraints:

1. Limitations or conditions that must be satisfied by the design.
2. Examples: Physical constraints, manufacturing constraints, safety constraints.

#### D. Optimization Problem Formulation:

1. Defining the objective function, design variables, and constraints.
2. Mathematical representation of the optimization problem.

### II. Single-Objective Optimization

#### A. Unconstrained Optimization:

1. Optimization without any constraints.
2. Direct search methods (e.g., exhaustive search, golden section search).
3. Gradient-based methods (e.g., steepest descent, Newton's method).

# Engineering Optimization Lecture Notes

**Zhe Xu**



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