

# Multidisciplinary System Design Methods

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# What Are Multidisciplinary System Design Methods?

- “How to decide what to change, and to what extent to change it, when everything influences everything else”
- Change a design problem into a mathematical statement
  - Objectives: Numbers to maximize or minimize
  - Constraints: Conditions that must be met
  - Design Variables: Numbers (Discrete or continuous) that designers can control

# Uses and Caveats

- Single disciplines often have conflicting goals
- Disciplinary specialists tend to generate side-effects in other disciplines
- Can find designs in unexpected regions of the design space
- MDSO is not a push-button system
- Methods do not replace good engineering judgement
- Computers do not innovate!
- Does not find “the best design” in a real-world sense

# Available Techniques and How We Can Use Them

- Design space exploration: concept comparisons in conceptual design stage
- Discrete optimization methods: Good design space coverage & treatment of discrete decisions
- Gradient-based optimization methods (one or several objectives): when models are available
- Local trade studies and parametric studies: help resolve competing disciplinary needs
- Sensitivity analysis (Effects of choice of objectives and constraints): Helps us evaluate formulation of the problem

# Challenges

- Large number of possible design variables, objectives, and constraints
- Some objectives and constraints are difficult to quantify and model
- Mixed discrete and continuous design variables
- Immature models
- Large amounts of interdisciplinary coupling

# References

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