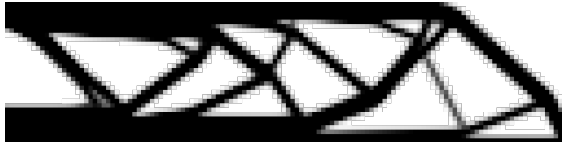


AML7870 - Topology and shape optimization

Prateek Gupta

Department of Applied Mechanics, IIT Delhi



Overview lecture
January 4, 2026
prgupta@am.iitd.ac.in





Previous courses

Structural optimization

Structural Optimization around us

AML7870 : Topology and shape optimization

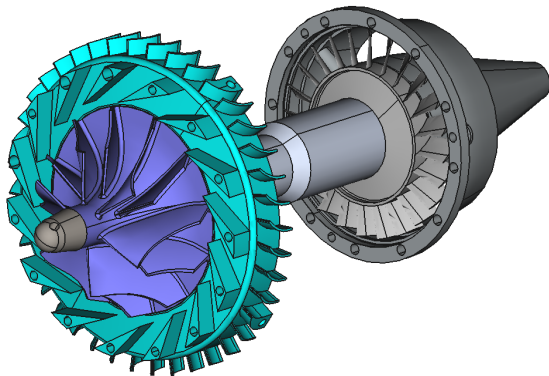
- Curve and surface modeling
- Introduction to design optimization
- Overview of different engineering analysis (FEM, CFD) techniques

CAD

Curve and surface rendering

CAE

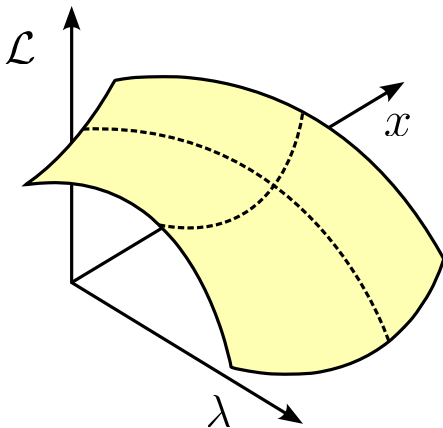
CFD, FEA, Atomistics



AML7020 : Optimization Methods

- Unconstrained optimization - Steepest descent, conjugate gradient, Newton based methods
- Constrained optimization - KKT, Dual problem

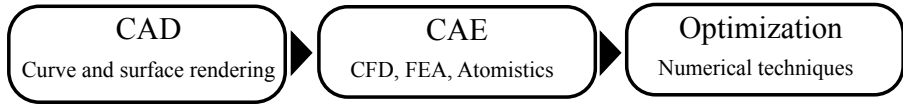
Optimization
Numerical techniques





Structural optimization

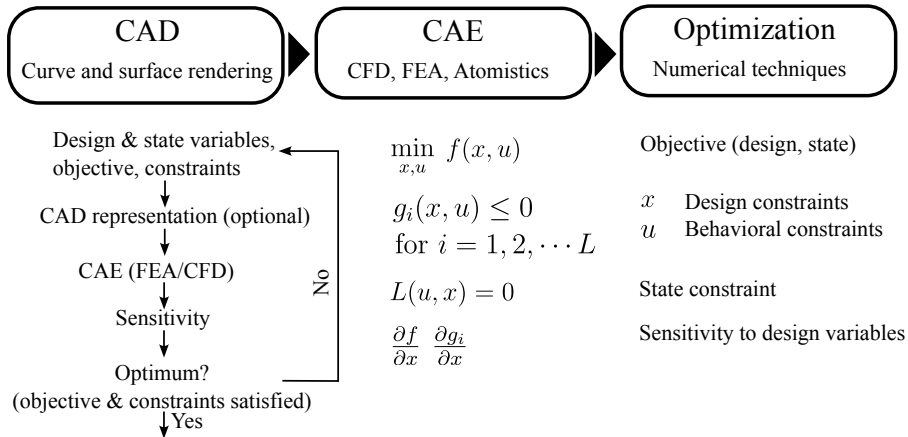
Structural optimization brings all these together



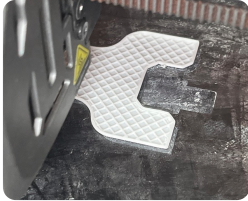


Structural optimization

Structural optimization brings all these together



Structural Optimization around us



3D printing

Boeing 747

<https://www.boeing.com>



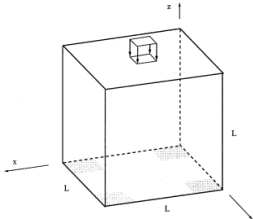
Chenab bridge



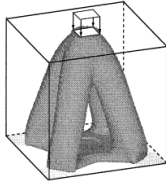
Marek et al. 2020



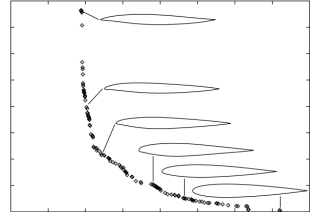
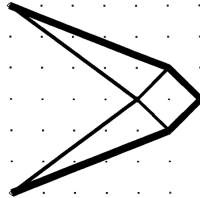
Upright assembly



Borvall & Petersson, 2001



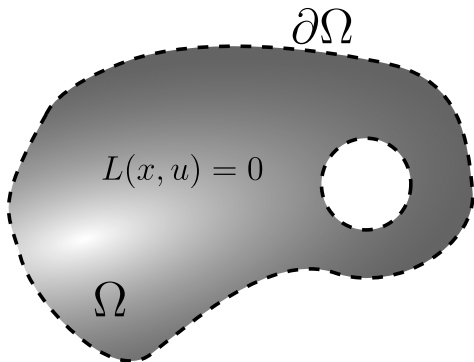
Ben-tal & Bendosoe, 1993



Haslinger & Makinen

AML7870 : Topology and shape optimization

- Structural optimization - sizing, topology, and shape
In topology and shape optimization, domain of the state problem changes with iterations $x = \Omega, \partial\Omega$.
- Constrained optimization - Sequential and convex approximations
Optimality Criteria, Convex linearization
- Sensitivity calculations - Discrete and Continuous cases
Adjoint method, adjoint calculations
- SIMP based topology optimization



AML7870 : Topology and shape optimization

- Course webpage :-
<https://web.iitd.ac.in/prgupta/TSO.html>
- Evaluation policy :- Mid-term exam (30%)
Major exam (30 %)
Term project (30 %)
Assignments (10 %)
- More details in the outline sheet

