

## Research topics for graduate students for 2024

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Acceptable course(s)

- Master's Degree
- Doctoral Degree



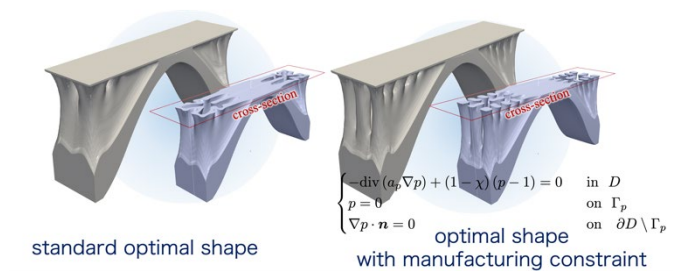
#### Research Topics

The main topic of research is computer-aided design methods, with topology optimization and mathematical modeling as our core technologies.

**Keywords:** *topology optimization, computational mechanics, computer-aided engineering, numerical analysis, optimal design methods, mechanism creation, meta-materials, multi-scale analysis*

#### 1. Partial Differential Equation (PDE) for manufacturability evaluation in topology optimization

Optimal shapes obtained by topology optimization are mechanically optimal, but the shape is often difficult to manufacture. To overcome the issue, we are working to develop mathematical models for manufacturability. The relationship between geometrical features and solutions of partial differential equations is studied theoretically.



#### 2. Design of meta-devices and meta-materials using topology optimization

We study design theories that exploit the expression of unusual properties to achieve unusual characteristics and functions or significantly higher performance.

#### 3. Design methods for robots and other mechanical systems based on extensions to topology optimization

We are expanding the framework of topology optimization to study design methods for mechanisms and robots.

#### Articles Related to Research Topics

- [1] Yamada, T. *et al.*, Topology optimization with a closed cavity exclusion constraint for additive manufacturing based on the fictitious physical model approach, *Additive Manufacturing*, Vol.52, (2022), p.102630. [ArXiv](#) [DOI](#)
- [2] Akamatsu, D. *et al.*, Two-phase topology optimization for metamaterials with negative Poisson's ratio, *Composite Structures*, Vol. 311, (2023), No.116800. [DOI](#)
- [3] Hirose, R. *et al.*, Multicomponent topology optimization method considering stepwise linear assemblability with a fictitious physical model, *Computer-Aided Design*, Vol.166, (2024), p.103628. [DOI](#)

Lab. Web page: <https://www.mid.t.u-tokyo.ac.jp/en/introduction/index.html>