Boundary Learning Optimization Tool

Tech ID: 29415 / UC Case 2017-996-0

SUMMARY

UCLA researchers in the Department of Mechanical Engineering have developed a computational tool that rapidly identifies material designs with optimal performance.

BACKGROUND

Analytical tools are necessary to rapidly optimize the performance of flexible materials that deform, yield, and/or buckle over large ranges of motion. The freedom and constraint topologies (FACT) synthesis approach helps designers rapidly consider and compare flexure systems that move in prescribed directions called degrees of freedom (DOFs) via elastic deformation. For synthesizing topologies that stiffly constrain the system's bodies to not move in certain directions while permitting them to move in other directions with high compliance (i.e., the DOFs), FACT helps designers determine the best number and kind of flexible elements (e.g., wire or blade elements). However, FACT does not consider the material properties and geometric parameters (e.g., the lengths, widths, or thicknesses of the flexible elements or the shape and size of the rigid bodies that the flexible elements join together within the system). Therefore, there is a need for a complementary tool that can optimize the geometric parameters of the topology solutions so that final designs can better meet performance requirements.

INNOVATION

UCLA researchers have developed a novel computational tool, called the Boundary Learning Optimization Tool (BLOT), that identifies physical performance boundaries (e.g. structural, thermal, electrical etc.) in a system governed by multiple constraints. The fully automated tool enables the geometric optimization of FACT-synthesized topologies. The AI-assisted data acquisition process leads to rapid and automated exploration of the full design space with minimal computational efforts. BLOT can be used with existing computer-assisted design and engineering software to improve the design experience for designers and engineers. BLOT can also be used to generate Ashby-like material plots for comparing properties of natural and engineered materials. These plots will help identify trends among engineered materials that result from microstructure rather than composition.

APPLICATIONS

- Flexible microarchitectured material design
- Material design optimization software
- Material process and selection software

ADVANTAGES

- Rapid and fully automated
- Minimal computational efforts
- Can be used with existing computer-assisted design and engineering software

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,159,226	12/03/2024	2017-996

RELATED MATERIALS

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Hopkins, Jonathan B.

OTHER INFORMATION

KEYWORDS

Boundary Learning Optimization Tool (BLOT), freedom and constraint topologies (FACT) synthesis, flexure topologies, geometric optimization, artificial intelligence, material performance optimization

CATEGORIZED AS

- **Computer**
  - Software
- **Engineering**
  - Engineering

RELATED CASES

2017-996-0

- A. Hatamizadeh, Y. Song, and J. B. Hopkins, Geometry Optimization of Flexure System Topologies Using the Boundary Learning Optimization Tool, Mathematical Problems in Engineering, 2018.

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Actively Controlled Microarchitectures with Programmable Bulk Material Properties
- Mattress for Bed Sore Prevention

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UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu