Inverse Design and Fabrication of Controlled Release Structures

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ABSTRACT

Researchers at the University of California, Davis have developed an algorithm for designing and identifying complex structures having custom release profiles for controlled drug delivery.

FULL DESCRIPTION

This technology introduces a novel topology optimization algorithm capable of designing objects that can release drugs at a controlled rate over time. Unlike previous methods that only addressed the creation of simple layered blocks, this algorithm allows for the design of complex, freeform geometries without the need for multi-material lamination. These geometries are optimized for direct 3D printing, leveraging geometric insights and a novel formulation based on the Eikonal equation to precisely control the dissolution dynamics of the object in a solvent, achieving desired release behaviors. This technology was co-developed with Max-Planck-Innovation (MPI). MPI's information related to this technology can be found at:

https://www.max-planck-innovation.de/technologieangebote/technologieangebot/controlled-release-structures.html.

APPLICATIONS

- Pharmaceuticals: Design and production of pills with precise release profiles for improved patient treatment.
- Biomedical Devices: Creation of implants and devices that deliver therapeutic agents over a controlled period.
- Consumer Products: Development of products requiring controlled release of flavors, fragrances, or active ingredients.

FEATURES/BENEFITS

- Enables the design of complex, freeform geometries for controlled release applications.
- Direct 3D printing of the designed objects without the need for additional support materials or complex multi-lamination processes.
- Reduces the trial-and-error process in drug release profile development through precise computational design.
- Supports single-material printing, making the technology accessible for a wide range of applications and printers.
- Overcomes limitations of previous algorithms that could not design complex geometries for controlled release.
- Eliminates the need for multi-material lamination, simplifying the manufacturing process.
- Significantly reduces the development time and cost associated with creating controlled release pharmaceuticals.

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INVENTORS

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OTHER INFORMATION

KEYWORDS

additive manufacturing (3D printing), gradient-based optimization algorithms, inverse design, additive-manufacturing penalty function, optimal design, release profile, STL files, three-dimensional design, voxel-based design, zero-order release curve

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