



SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS1022

20 November 2025

A DCAMM seminar No. 797 will be presented by

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The title of the lecture is

Bridging Design and Additive Manufacturing of Programmable Materials

Abstract:

Programmable materials capable of adaptive, controllable, and stimuli-responsive behaviors are enabling a new generation of functional devices in soft robotics, bio-integrated systems, and smart structures. Realizing their full potential requires synergistic integration of computational design and advanced fabrication strategies.

In this talk, we present strategies that bridge the designs and additive manufacturing to enable the physical realization of programmable materials with multiphysics interactions. Computational designs with various programmable properties are generated by multi-material, multi-physics topology optimization approaches that optimize geometry, material distribution, and internal architectures to achieve targeted mechanical and actuation responses under large deformations. To fabricate the obtained designs with complex geometries and heterogeneous material/phase distributions, we introduce various techniques, including a hybrid fabrication method, tailored path generation methods, and 4D direct ink writing (DIW) techniques. The latter methods align local material orientations and printing paths with optimized fields, allowing the physical realization of designs with continuous distributions. We demonstrate this integration through experimental validation of diverse functional prototypes, including soft multimaterial metastructures, magnetically responsive materials with spatially varying magnetization patterns, and liquid crystal elastomer (LCE) systems capable of complex temperature-driven morphing behaviors.

These developments represent a step toward programmable matter whose properties and responses can be tailored and reconfigured by design and manufacturing for applications in responsive actuation, reconfigurable devices, and intelligent system.

DATE:	Thursday, 4 December 2025
TIME:	14:30 – 15:15
PLACE:	Building 414, Room 065E DTU, Technical University of Denmark

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Ole Sigmund/Jan Becker Høgsberg

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