VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Efstration Polyzos**

The public defense will take place on **Friday 13th December 2024 at 5pm** in room **I.0.02** (Building I, VUB Main Campus)

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STRUCTURAL MODELLING OF 3D-PRINTED COMPOSITES

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Abstract of the PhD research

Additively manufactured composites with continuous fibers (3D-printed cFRPs) are prominent for use in the industry since they can obtain properties close to metals and also allow manufacturing of complex geometries without molds. Despite their importance, the behavior of 3D-printed cFRPs remains insufficiently understood, limiting their potential. In this thesis, the physics that governs the elastic and damage behavior of 3D-printed cFRPs is explored through structural modeling. The material is studied across different length scales ranging from the scale of fibers to that of full parts. To this end, ideal and real models are developed utilizing novel theories and micro-computed tomography or microscopy images, to investigate the influence of fibers and voids on the elastic behavior of 3D-printed cFRPs. Once the fundamentals of the elastic behavior are established, the models are extended to include fiber damage, one of the most important failure mechanisms of 3D-printed cFRPs. The novel models are additionally compared with experimental data, demonstrating excellent agreement. This thesis forms a foundation stone for more elaborate modeling strategies aimed at advancing the field of 3D-printed cFRPs and composites in general.