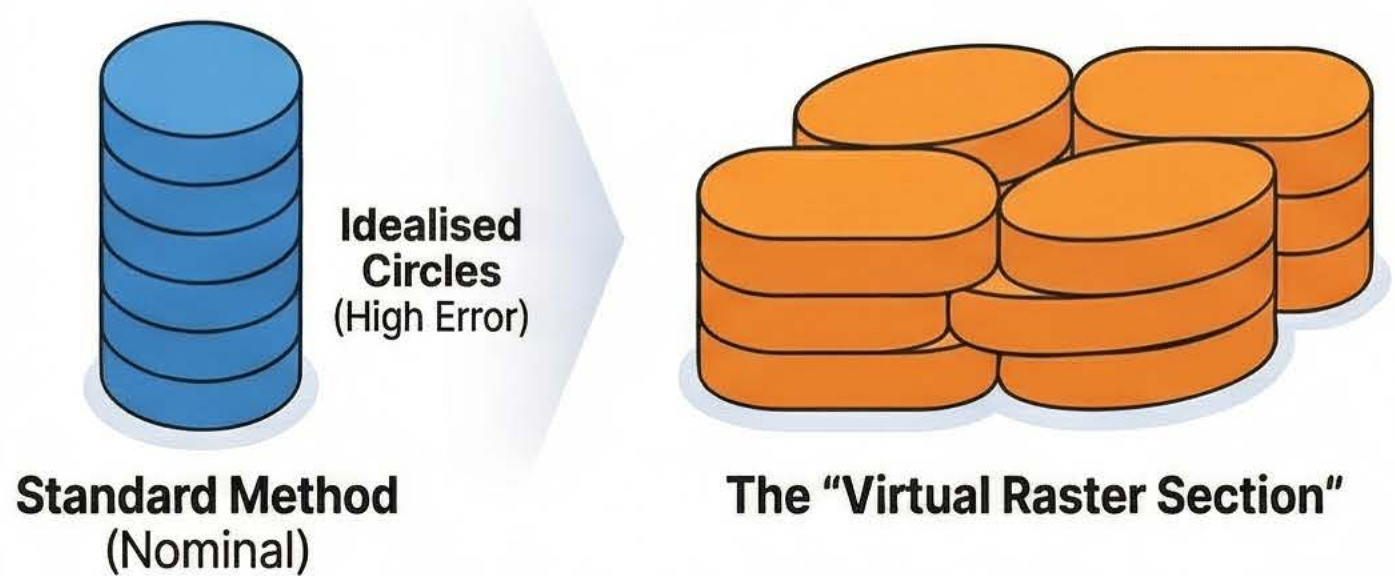


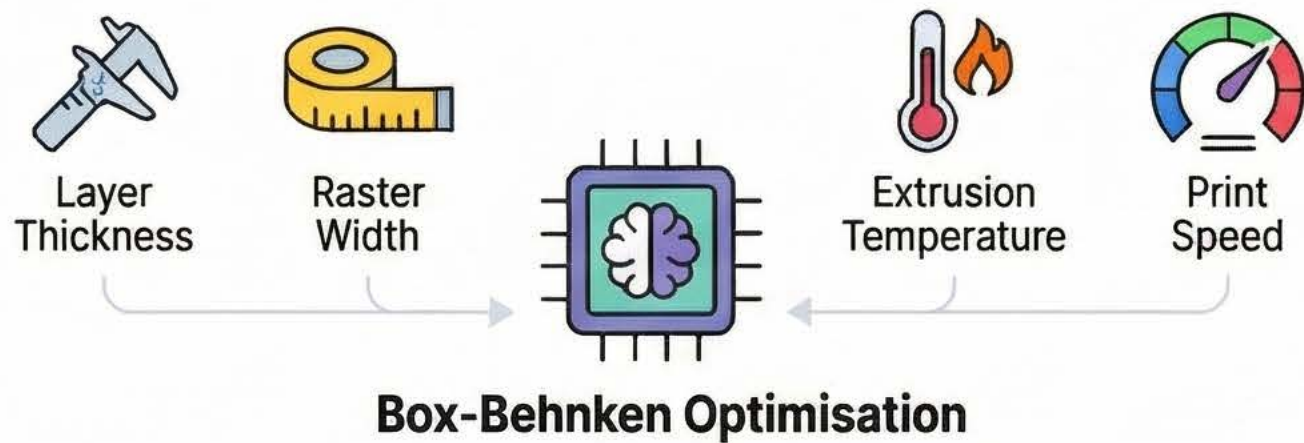
High-Accuracy 3D Printing Simulation: The G-Code to Abaqus Pipeline

Standard FDM simulations use idealized circular filament models, leading to prediction errors >15%. This research introduces a Python-based "G-code-to-Abaqus" tool that uses experimental calibration for a "Virtual Raster Section" accounting for real-world deformation to achieve near-perfect accuracy.

SECTION 1: THE CALIBRATION PIPELINE (INPUT TO MODEL)



Supporting Detail: Replacing idealised circles with oval-rectangular shapes that mimic real-world filament flattening and spreading.



1.06% Thickness Accuracy

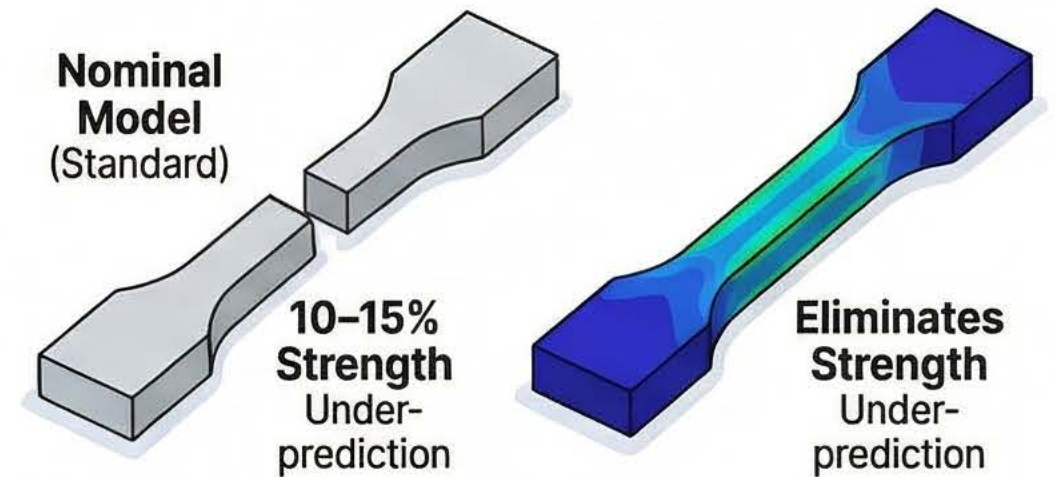
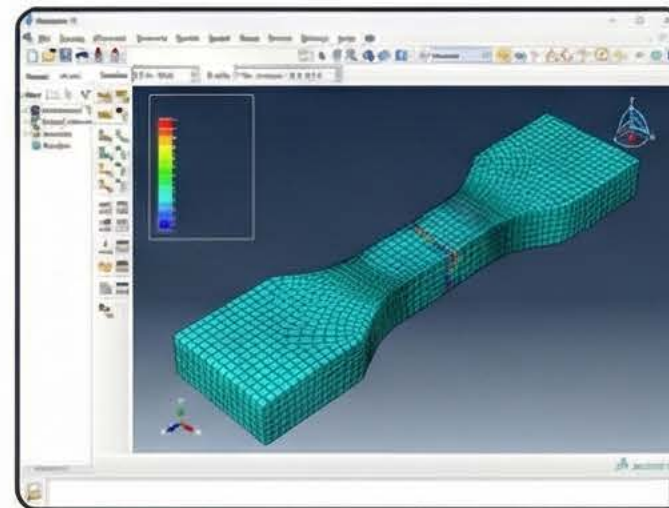
The mathematical model achieves near-perfect alignment between experimental filament thickness and virtual simulation parameters.

SECTION 2: VALIDATION AND PREDICTIVE POWER



Automated Geometry Engine

A Python interface parses G-code to generate mesh-ready solids directly within the Abaqus environment.



Corrected vs. Nominal Models

<1% UTS Prediction Error

The corrected model predicts Ultimate Tensile Strength (UTS) with less than 1% error for 90° orientations.

UTS Prediction Accuracy (Corrected vs. Experimental)

