NAFEMS UK Regional Conference 2018 - Abstract Submission

Submission Date	2018-02-01 03:49:05
Name	Dr. Karl-Michael Nigge
Job Title	Head of Product Management
Company	Volume Graphics GmbH
Please identify the event for which your submitting?	NAFEMS UK Conference 2018
Will you be the presenting author?	Yes
Presentation Title	Simulation of the Stress Concentration around Pores in 3D Printed Components
Relevant Themes / Keywords	additive manufacturing, porosity, stress concentration, computed tomography, CT, micromechanics simulation, immersed boundary methods

Abstract (plain text)	Lightweight design increasingly leads to complex shapes resulting from bionic optimization which are increasingly being produced by 3D printing. Their mechanical properties may be particularly sensitive to defects such as porosity caused by the printing process. While porosity may be reduced or shifted to less critical zones, it may not be efficient to completely avoid it in a parameter optimization which also takes production cost into account. Much rather, it would be desirable to include a quantification of the detrimental effect or otherwise of pores in production parameter optimizations. An application of classical FEM simulation to this problem would require a geometry conformant mesh which does not only represent the external surface of the component but also the much more complex internal surface resulting from the pores. Due to the potentially high number and small size of the pores, the time required to generate the mesh and the computational effort for the simulation may quickly increase beyond practical limits. Recently, immersed-boundary finite element methods have been used to overcome this meshing problem. This approach is implemented in the Structural Mechanics Simulation module of VGSTUDIO MAX by Volume Graphics to simulate local stress distributions directly on computed tomography (CT) scans which accurately represent complex material structures and internal discontinuities. As a validation of this simulation approach, a comparison between simulated and experimental results of tensile tests was conducted for two types of additively manufactured AlSi10Mg components, a tension rod and a bionically optimized aeronautic structural bracket. Both the tensile strengths as well as the locations of the first crack occurrences were in good agreement between simulations and experiments. The approach was also successfully validated against a classical FEM simulation for a solid cube and a cubic lattice which were 3D printed from Ti6Al4V. The combination of widely used CT based metrology and defect analysis with this simulation approach for the assessment of potential effects of defects opens up the perspective of using computed tomography as a comprehensive method for the quality assurance of 3D printed parts.
Please enter any additional comments or messages here	Corresponding Author: Dr.-Ing. Karl-Michael Nigge, Volume Graphics GmbH Authors: Karl-Michael Nigge, Johannes Fieres, Christof Reinhart (Volume Graphics GmbH, Germany), Philipp Schumann (Concept Laser GmbH, Germany)
abstract id	UK18-21