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Fredrick Madaraka Mwema ·
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Fused Deposition Modeling

Strategies for Quality Enhancement

Springer

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Preface

Fused deposition modelling (FDM) is one of the most progressive and advanced Additive Manufacturing (AM) methods for the modern industry. The method has proven its suitability as a rapid prototyping technique and for the production of intricate functional components. However, the process faces two major limitations; poor surface quality and limited range of materials as it is mostly applicable to polymer-based raw materials. There are therefore extensive efforts by the AM researchers to enhance the quality of FDM parts and expand its application in different fields.

This book contributes to these continued efforts by presenting different strategies for quality enhancement of the technology. In the book, the terms FDM and 3D printing have been used interchangeably and they have the same meaning. The book is presented in four chapters. In Chap. 1, a general introduction to the fused deposition modelling is presented. A glimpse into different methods of AM technology, science of FDM and its applications, process parameters and quality aspects of FDM technology are presented in this chapter. Most importantly, the role of 3D printing in the fight against Coronavirus disease of 2019 is discussed in Chap. 1. In Chap. 2, a full factorial approach for the design of experiment (DOE) based on different levels of print orientation and layer resolution during FDM of PLA simple samples is presented as a strategy for enhancing both surface finish and microhardness properties. In Chap. 3, a multi-objective optimization approach is presented as another strategy for quality enhancement of FDM parts using case studies both from the literature and the experimental work by the authors. Finally, surface engineering technology is presented as a strategy for enhancing the surface and functional quality of the FDM parts in Chap. 4.

All the borrowed information such as methods, data and figures have been acknowledged accordingly inside the text. It is the hope of the authors that the book will, holistically, contribute towards expanding applications of fused deposition modelling parts. The book is suitable for engineers, researchers, academics and industrialists in the 3D printing field.

We acknowledge Springer for accepting to publish this work and the professional support they have accorded to us in the course of developing the idea and writing of the manuscript.

Nairobi, Kenya — Fredrick Madaraka Mwema
Johannesburg, South Africa — Esther Titilayo Akinlabi

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Fredrick Madaraka Mwema Dr. F. M. Mwema is a postdoctoral researcher and a lecturer at the University of Johannesburg, South Africa and Dedan Kimathi University of Technology, Kenya, respectively. He is currently the Head of Department of Mechanical Engineering Department at Dedan Kimathi University, Kenya. He obtained BSc and MSc degrees in Mechanical Engineering from Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya, in 2011 and 2015, respectively. He has a PhD in Mechanical Engineering from the University of Johannesburg, which he obtained in 2019. His PhD research work involved thin film coatings for surface protection and functional components. He has interests in advanced manufacturing, severe plastic deformation processes, additive manufacturing, thin film depositions, surface engineering, and materials characterizations. In thin films, Dr. Mwema has interest in fractal theory of coatings for enhanced depositions and behaviour in advanced applications. He has published more than 50 articles in peer-reviewed journals, conferences, and book chapters. He supervises and mentors several students, currently with 4 masters and 3 PhD students. He has over 6 years of university teaching and training experience in mechanical engineering undergraduate subjects.

Esther Titilayo Akinlabi Professor Esther Titilayo Akinlabi is a Full Professor at the Department of Mechanical Engineering Science, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa. She has had the privilege to serve as a Head of the Department of Mechanical Engineering Science and as the Vice Dean for Teaching and Learning at the University of Johannesburg. Her research interest is in the field of modern and advanced manufacturing processes—friction stir welding and additive manufacturing. Her research in the field of laser-based additive manufacturing includes laser material processing and surface engineering. She also conducts research in the field of renewable energy, and biogas production from waste. She is a rated National Research Foundation (NRF) researcher and has demonstrated excellence in all fields of endeavours. Her leadership, mentorship, and research experience are enviable as she guides her team of postgraduate students through the research journey. She is a recipient of several

research grants and has received many awards of recognition to her credit. She is a member of the prestigious South African Young Academy of Science and is registered with the Engineering Council of South Africa. Professor Akinlabi has filed two patents, edited two books, published five books, and authored/co-authored over 400 peer-reviewed publications.