

## FUTURISTIC APPROACH FOR TOPOGRAPHY USING FUSED DEPOSITION MODELING PROCESS AND VARIOUS CHARACTERIZATION

SUDHANSHU MALIK, Mr. Sunil Sharma, Assistant Professor - Guide  
ABSS INSTITUTE OF TECHNOLOGY, MEERUT, U.P. (INDIA)

### SUMMARY

*THE AUTHOR IN THIS PAPER REVIEWS THE AMPROCESS (ADDICTIVEMANUFACTURING), GENERALLY KNOWN AS THE FUSED DEPOSITION MODELING PROCESS (FDM). DISCUSSION OF VARIOUS PARAMETERS OF FDM PROCESS, THE OPTIMAZATION OF THE TOPOGRAPHY, IT'S VARIOUS APPLICATIONS USING THE FUSED DEPOSITION MODELING PROCESS AND CHARACTERIZATION OF PARTS.*

### ABSTRACT

FUSED DEPOSITION MODELLING (FDM) IS AN ADDICTIVE MANUFACTURING PROCESS (AM PROCESS) WHICH IS OFTENLY USED FOR FABRICATION OF GEOMETRICALLY COMPLEX SHAPED PROTOTYPES AND ITS PARTS. THIS PROCESS REDUCES THE CYCLE TIME FOR DEVELOPMENT OF THE PRODUCT WITHOUT NEEDING ANY EXPENSIVE TOOL. THE COMMERCIALIZATION OF THE FDM TECHNOLOGY IN INDUSTRIES AND ITS APPLCATIONS IS LOW BECAUSE OF ITS INSUFFICIENT MECHANICAL PROPERTIES , VERY POOR SURFACE QUALITY, LOW DIMENSIONAL ACCURACY.THE FDM PRODUCED PRODUCTS ARE AFFECTED THROUGH VARIOUS PARAMETERS , SUCH AS, RASTER WIDTH, BUILD ORIENTATION, LAYER THICKNESS, OR PRINTING SPEED.THIS PAPER INTENSIVELY REVIEWS THE STATE OF ART LITERATURE BY INFLUENCING THE PARAMETERS OF PART QUALITIES AND THE WORKING PROCESS PARAMETER OPTIMIZATION.

### KEYWORDS

FUSED DEPOSITION MODELING, PROCESS PARAMETERS,OPTIMIZATION, CHARACTERISTICS OF PARTS

### INTRODUCTION

FUSED DEPOSITION MODELING(FDM) IS WIDELY USED TO PRODUCE VISUAL AIDS, CONCEPTUAL MODELS, AND PROTOTYPES, AND ALSO USED TO PRODUCE SOME FUNCTIONAL PARTS AS DRILLING GRIDS IN THE AEROSPACE INDUSTRY, EDENTULOUS MANDIBLE TRAYS. AM PARTS ARE ALSO USED IN VARIOUS APPLICATIONS SUCH AS WITH DIFFERENT SURFACE FINISH AND SURFACE INTEGRITY REQUIREMENTS.THOUGH IN MANY APPLICATIONS, THE AM PARTS ARE USED IN A PATTERN TO TRANSFER THE GEOMETRIC AND DIMENSIONAL INFORMATION TO OTHER DOWNSTREAM MANUFACTURING PROCESSES, WHICH COULD MAKE THEIR ACCURACY OF SURFACE MUCH CRITICAL.

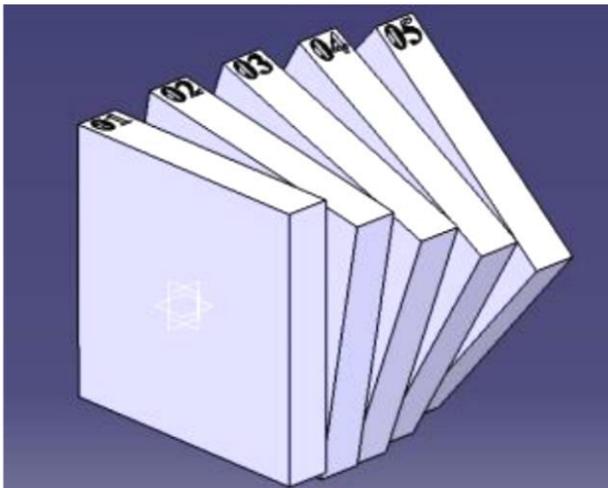
A VERY LARGE NUMBER OF RESEARCHERS ANALYZED THE CONTROLLABLE PARAMETERS TO ACHIEVE THE DESIRABLE PROPERTIES OF THE PARTS.

MANY RESEARCHERS WORKS ON OPTIMIZING THE PROCESS PARAMETERS.

THIS PAPER DESCRIBES THE FUSED DEPOSITION MODELING (FDM), IT'S PARAMETERS OF PROCESSING, EQUIPMENTS USED, ANDMATERIALS, ALSO REVIEWS THE EXISTING PAPERS ON CHARACTERISTICS OF FDM

PARTS. VARIOUS WORKS ON NUMERICAL PROCESS PARAMETER OPTIMIZATION FOR THE FDM PROCESS ARE ALSO DISCUSSED. CHALLENGES, OPPORTUNITIES, AND FUTURE RESEARCH AREAS IN THE DEVELOPMENT OF FDM.

### FUSED DEPOSITION MODELING



**CAD MODEL & FDM PRINTS OF THE TRUNCHEON STUDY ARTEFACTS (MODIFIED)**

### METHODOLOGY

THE VARIOUS TRUNCHEON ARTEFACTS WHICH ARE PRINTED ON ZORTRAX M200 WITH ABS (ACRYLONITRILE-BUTADIENE-STYRENE) THERMOPLASTIC FIBER. THE QUALITY OF THE PRINT IN THESE THERMOPLASTIC FIBRES ARE VERY HIGH WITH A LAYER THICKNESS OF 0.09MM, 0.19MM & 0.29MM.

### EVOLUTION OF VARIOUS SURFACES

THE SAMPLE OF THE SURFACES ARE TAKEN USING A THREE DIMENSIONAL MEASUREMENT FROM THE CONTACT OF PROFILOMETER. TAYLOR HOBSON STYLUS PROFILOMETER IS USED AS AN INSTRUMENT FOR THE MEASUREMENT. THE MEASUREMENT AREA ARE 2.5MM \* 2.5MM.

THE SURFACES WHICH ARE CAPTURED ARE BEING ANALYSED IN THE MOUNTAINS MAP SOFTWARE . THE PARAMETERS OF AREAL SURFACE ARE DEFINED THROUGH ISO 25178-2:2012, WHICH EVALUATE THROUGH VARIOUS SURFACES AND ARE GENERATED IN DIFFERENT LAYERS OF THICKNESS AND THE BUILD ANGLE.

### SIGNIFICANT FEATURES

THE PARAMETERS OF THE SURFACE ARE VARIED RANDOMLY IN SUFACE FEATURES AT DIFFERENT SCAL OF THE MEASUREMENTS. ON COMPARING THE VARIOUS SURFACES AT A PARTICULAR SCALE, IT IS NOT IMPORTANT TO CHARACTERIZE ALL THE PRESENT SURFACE FEATURES.

FOR THE ANALYSIS OF THE TOPOGRAPHY DATA IN FOURIER TRANSFORM , THE POWER SPECTRAL DENSITY (PSD) IS USED FOR OBTAINING THE VARIOUS CONTRIBUTION AT DIFFERENT LATERAL SCALES.

THIS TECHNIQUE IS USED TO REPRESENT THE VARIOUS PROPERTIES OF THE SURFACE PARAMETERS SUCH AS ALL WAVE LENGTHS, OR SPATIAL SIZES , OF THE FEATURES OF SURFACE TEXTURE.

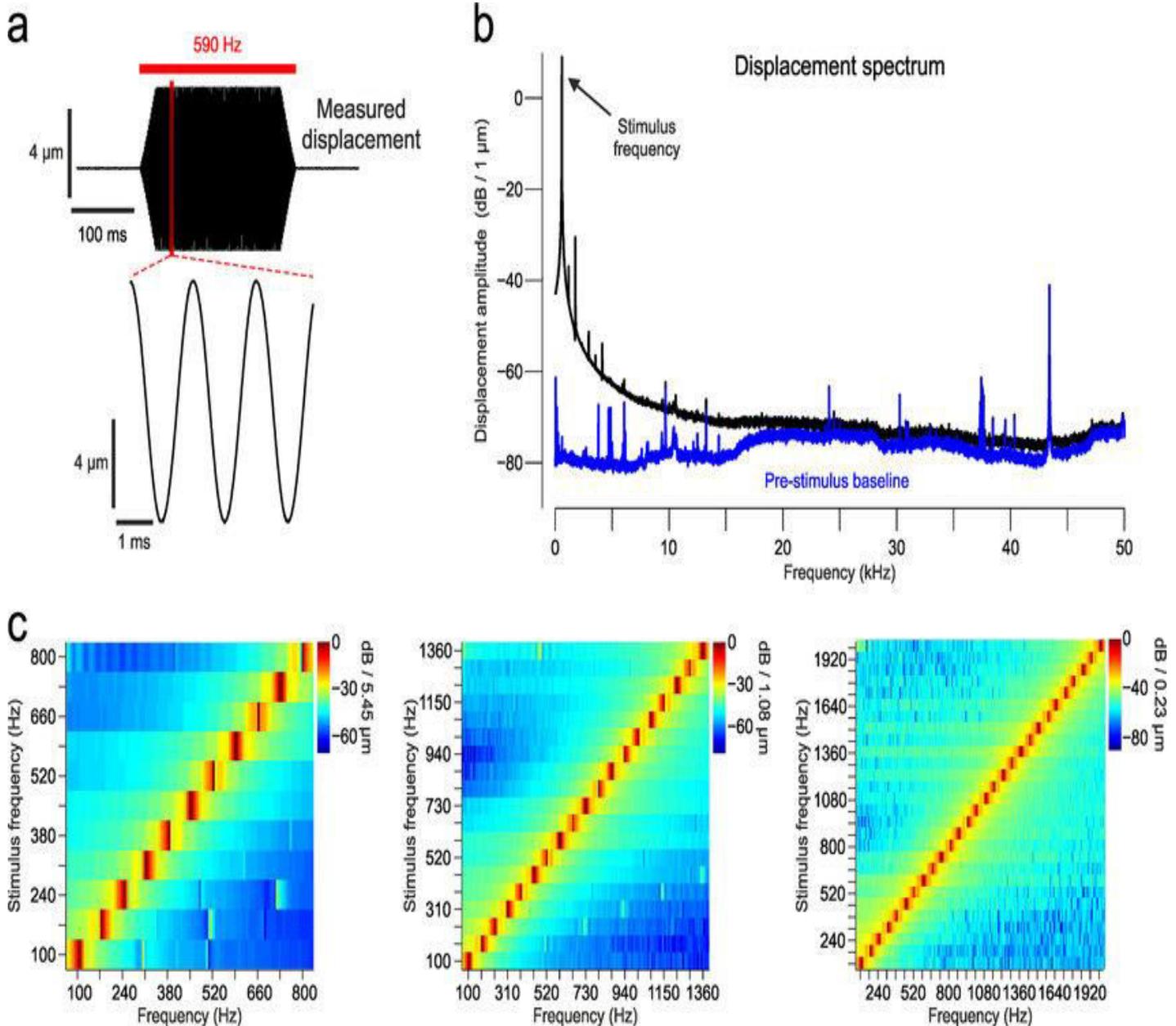
ANOTHER TECHNIQUE USED IS MULTIPLE REGRESSION ANALYSIS. THIS ANALYSIS IS USED TO DETERMINE THE VARIOUS SIGNIFICANT SURFACE PARAMETERS WHICH ARE BASED ON COEFFICIENT OF DETERMINATION (R<sup>2</sup>) , SIGNIFICANCE OF THE F & P VALUE OF THE REGRESSION COEFFICIENTS.

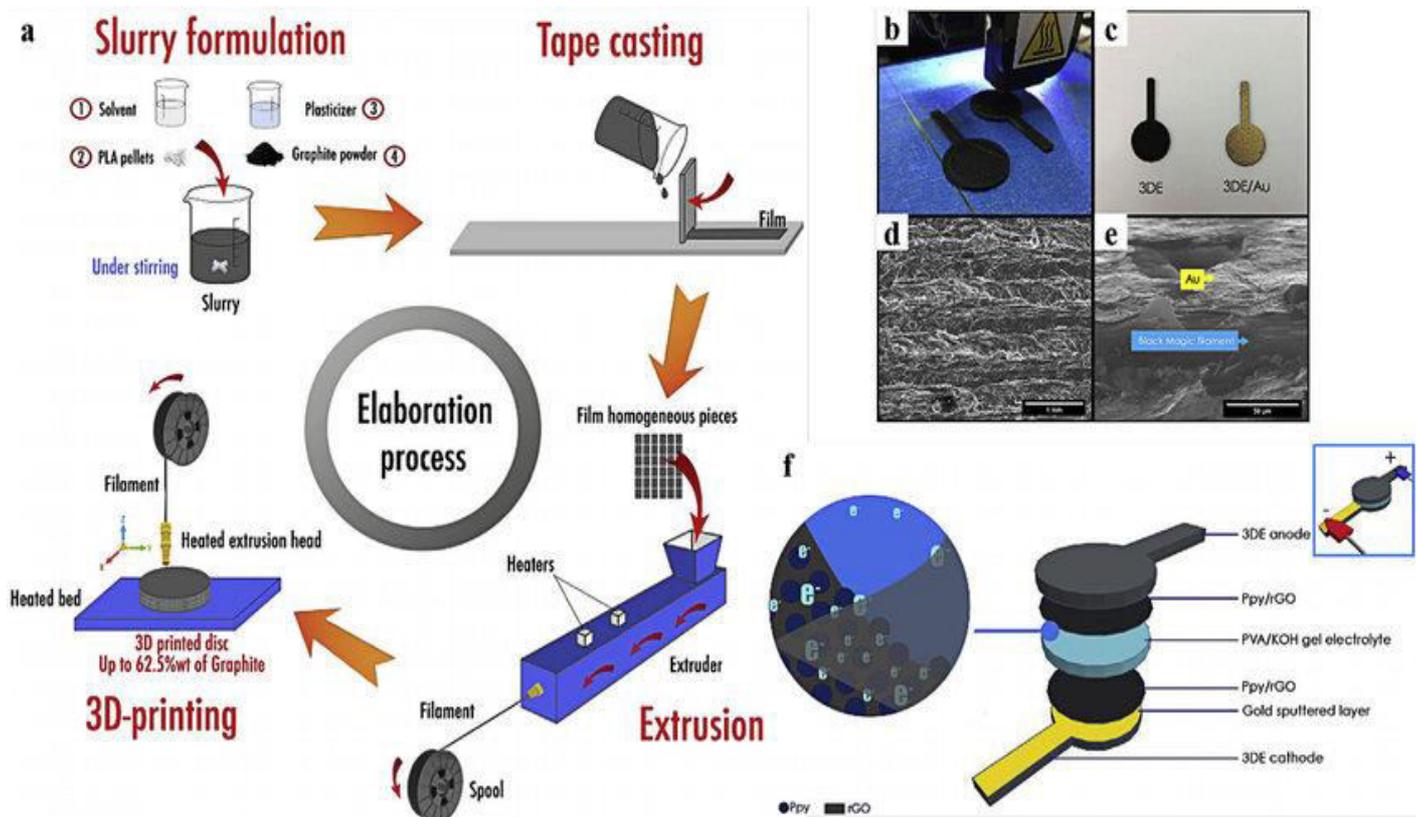
THE LAYER THICKNESS AND THE BUILD ANGLE ARE EXPLAINED THROUGH THE

VALUE OF R<sup>2</sup>. AS THE VALUE OF R<sup>2</sup> INCREASES , VARIABILITY OF THE

SURFACE PARAMETER, THICKNESS AND BUILD ANGLE ALSO INCREASES.

THE F EXPLAINS THE NON-RANDOMNESS IN THE DATA AND P – VALUE ( CONFIDENCE INTERVAL OF 95%) AND HELPS TO DETERMINE THE SIGNIFICANT INFLUENCE OF THE INDIVIDUAL PROCESS VARIABLE.





## RESULTS & DISCUSSIONS

THE DEVELOPED TECHNOLOGY IS USED FOR THE THREE DIMENSIONAL PRINTING ON THE THERMOPLASTIC FIBRES WHICH USED WIDELY FOR VARIOUS APPLICATIONS. THIS TECHNOLOGY INVOLVES THE FUSED DEPOSITION MODELING PROCESS WHICH HAS A GOOD SCOPE IN FUTURE. THE POWER SPECTRAL DENSITY PARAMETER USED IS A NEW TECHNOLOGY WHICH IS USED TO ANALYSE THE TOPOGRAPHY DATA IN FOURIER TRANSFORMS, WHICH HELPS IN OBTAINING THE VARIOUS PROPERTIES OF PRINTING.