Feature Based Tool Path Generation System for FDM

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Abstract— *Integration of Computer Aided Design and Manufacturing process in important for any firm during its business operations. An important aspect in this step is modelling of the part using manufacturing features. These features explicitly capture manufacturing attributes. This process is implemented in many of the CAM software for conventional manufacturing processes. But when it comes to special processes like 3D printing, this philosophy has not been implemented. The way the code is generated for 3D printing is quite different when compared to conventional manufacturing. Slicing is used for generating the code during 3D Printing. The generated part model is exported to stl file and this stl file is then sliced along z-direction to facilitate code generation. The current work investigates into use of feature based modelling to simplify slicing techniques. Based on the modelling, a z-buffer of loops is generated. This z-buffer is modified each time a feature is added to a part. This z-buffer is then used to generate the code. This process helps in quicker modification of code by eliminating the need of exporting and slicing each time. This helps integrating the 3D printing module into any CAD software thus eliminating the slicing procedure partially. This also helps in controlling the errors and tolerances in the part generated by 3D Printing. As a part of implementing this principle, AutoCAD customized using VB.NET.*

Keywords— ***3D Printing, Feature Based Modeling, Automatic code generation, Z-Buffer, CAD.***

I. INTRODUCTION

3D Printing is finding a lot of applications in daily life especially when it comes to prototyping, irrespective of the field in which it is being employed. Ze-Xian Low, et al [1] compared 3D printing techniques and conventional manufacturing techniques that can be used for membrane manufacturing. Spahiu, et al [2] described how 3D printing can be used in textile industry. Wong [3] reviewed the application of 3D printing in orthopedics. Abdul Azeez, et al [4] used 3D printing techniques for fabricating support for hand drop disorder. P Vivek, et al [5] used 3D printing to fabricate a low cost prosthetic hand with EPS foamed fingers.

Basic 3D printing machines are G-Code based.The G-Codes are listed in [6]. There are multiple ways in which these codes are generated. Starly, et al [7] extracted the geometry from STEP files and then sliced the geometry to generate toolpath. Udroiu, et al [8] reviewed Polyjet printing process for different applications. Donghong Ding, et al[9] reviewed good amount of literature relating to slicing of objects. The problems during generation of stl file and using them to generate the tool path for 3D printing, tolerencing methods are discussed. Various criteria based on which tool path is computed is also presented in the same paper. Marco Livesu, et al [10] reviewed various aspects of process planning relating to 3D printing. Various aspects involve solving problems during import of geometry, planning for 3D printing like orientation of the object, determination of use of supports and the way to be generated, selection of process parameters etc. Kao & Prinz [11] discussed a method to reduce the gaps and errors that are produced in 3D printing when printing objects with sharp corners. Pandey, et al [12] reviewed classification of slicing algorithms, the algorithms involved and tolerencing methods currently in practice. Siraskar [13] used octree technique to determine layer height for improving accuracy and reduce stair case effect. Lensgraf and Mettu [14] described an algorithm to reduce waste moves using the existing methods but also utilizing local dependencies between parts of the model to ensure that printing and movement in three dimensions produces the target model and is collision- free. G Q Jin, et al [15] developed an algorithms for generating zig-zag tool path using hybrid and adaptive techniques. Mateusz Wojcik, et al [16] generated a tool path for fused deposition process using Modified Zig Zag pattern optimized using GA. Yu-An Jin [17] developed a slicing methodology for generating tool paths for 3D printers based on FDM techniques taking surface accuracy and fabrication efficiency into consideration. Various examples are presented in this regard. Kai-Yin Fok, et al [18] devised a modified travelling sales man algorithm to optimize the toolpath generated for