UNIVERSITI TEKNOLOGI MARA

G^2 PARAMETRIC CURVE AND SURFACE FITTING USING BETA-SPLINE

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Computer and Mathematical Sciences

May 2015

AUTHOR'S DECLARATION

I declare that the work in this research was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not yet been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Advancement of the imaging technology nowadays demands sophisticated method to represent the captured image in the form of curves and surfaces. However, the challenge in curve and surface fitting techniques is the smoothness and accurateness of the result and the complexity of the techniques. Therefore, the primary goal of this research is to develop new curve and surface fitting techniques using beta-spline which has G^2 continuity, high accuracy and less number of computations. This is due to the properties of cubic beta-spline itself with G^2 conditions, and located close to the control polygon. Additionally, beta-spline can be controlled in three ways using control points, shape parameters and weights. In beta-spline curve fitting, the control points are calculated using least squares method. The data points are first segmented in corner detection process, then the curve control points are calculated based on the corner points. The developed curve fitting technique is applied on 2D font of 'ى' (ya) and'ϵ' (epsilon). The results are then compared with the another technique using B-spline in terms of total processing time, approximation error, and the number of computation in the algorithm. For beta-spline surface fitting, a new technique to solve branching contours has been carried out. An intermediate contour called composite contour is generated and inserted between the two adjacent image slices. Beta-spline surface is then fitted to the extracted data points from each slice. The developed surface fitting algorithm is applied on 3D Computerized Tomography (CT) image of human face and Stanford bunny. The reconstructed 3D images are compared visually with the images using the other techniques. The results show that the reconstructed images using beta-spline surface give similar result obtained using the other techniques.

ACKNOWLEDGEMENT

First above all, I praise Allah S.W.T. for His guidance in my life and my PhD journey. There is no God but Him. Only from Him we seek for help. Surely my prayer, my sacrifice, my life and my death is for Him.

I would like to thank my supervisors Prof Arsmah Ibrahim, Dr Fatimah Yahya and Prof Jamaludin Md Ali for supporting me during this study. I really appreciate your encouragement, comments and thoughts. Without your supervision, my research will not be as it is today. I wish one day I can be as excellent as all of you. I really hope we can still sit together and continue our research cooperation.

For my mother and father, this is my present for you. Thank you for bringing me up in a good way. Only Allah can reward your sacrifice. I hope this will make you proud and happy. For my brother and sisters, take this as a motivation for you to be success in your life. Thank you for always helping me in managing everything. I love all of you so much.

For my beloved husband, thank you for being my other half. For you and our children, I really appreciate your patience, support and assistance. May Allah bless us and unite us in goodness.

For my friends especially my colleagues in FSKM, I will miss our sharing time during this study. We share a lot of things together. Thank you for always be so supportive. I pray for our success in our career, life and after life.

Last but not least, for everybody those directly or indirectly contribute to this study. Thank you very much.

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND

Digital representation of objects and signals is very useful in this digital world (Koundinya, Jaikumar, Akash, & Subramanian, 2012). The scope of digitization has broadly expanded, being in various areas such as astronomy, microscopy, seismology, security, manufacturing and medicine. The current technology of digitization enables the study of all things from micro cell movement and heart beat to the structure of galaxies with better visualization. Thus, thorough analysis of the related studies can be done and most importantly the information generated can be shared with interested parties. In medical technology for example, images can be generated in 2D, 3D and 4D form enabling analysis to be carried out for use in diagnosis and treatment (S. Q. Wang, Feng, & Guo, 2012).

Digitization is a process of capturing objects, sound, and signals that are then represented in digital form in terms of points or samples. Digitization of a signal in sample form consists of values at a point in time or space. For objects, the digital representation is in image form of 2-dimensional (2D) array of intensity value. Numerous processes can be done on a digital image such as enhancement, segmentation, extraction, and analysis. Digital images help in understanding the objects that they represent especially for unreachable objects such as micro-organism and human internal organs. In digital form, the image of these objects can be rescaled and enlarged so that the analysis can be done thoroughly.

The advanced technology in digitization has also been widely applied in the field of recognition. In security for example, digitization has been used in the access control to increase the reliability of the access key. The current technology allows the access key to be in voice, face, and biometric form such as palm print, fingerprint and iris rather than keyword form. The access machine will capture the scanned object or signal, process the information, and decide whether the object or signal belongs to the database. Recognition has also been applied in classifying images such as tumour diagnosis (Rosenkrantz, Mussi, Hindman, Lim, Kong, Babb, Melamed, & Taneja,