Construction of Basketball Shoe Sole Design by Using Bezier Curves

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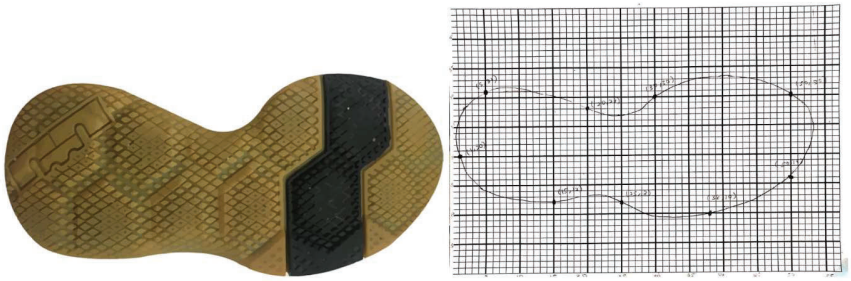
Introduction

Computer-aided geometric design (CAGD) plays an important role in the design world. In designing curves and surfaces, CAGD deals with mathematical expressions to regulate shapes by Bizzarri & Lavicka (2011). CAGD has several types of polynomial curves such as Bezier, Said-Ball, Wang-Ball, and DP curves. There are some common and specific properties in these curves. All of them are defined in terms of the total sum of their mixing and control points functions. Each of the polynomials has its own speciality as stated by Bizzarri & Lavicka (2011). This study chooses to use the Bezier curve to construct the shape of a basketball shoe sole. Bezier curve is an important tool used in vector graphics to model smooth curves that can be scaled indefinitely. The principle of continuity is then extended to an aim of smoothness or visually nice curves and surfaces as claimed by (Yahaya, 2015).

Shoe is footwear that every human uses since it gives protection to their feet. There are a variety of types of shoes to be used by humans. The design of the shoe sole is very important and people need to consider it so they can use it for a long time. The focus of this study is on sport shoes which are basketball shoes that are usually used by the basketball players.This study wants to differentiate the degree evaluation from lower degree to higher degree for Bezier curve of basketball shoe pattern and to determine the computation times of the outsole of the shoe. Figure 1(a) shows the original figure of the basketball shoe sole while the second figure shows the drawing of the basketball shoe sole on the graph paper (Figure 1(b)).



(a) The original figure (b) drawing

Figure 1: The original figure and the drawing of basketball shoe sole

Methodology

Wang et al. (1996) gave a parameter Bezier bend for degree n with n+1 control focuses $\{p_i\}_{i=0}^{n}$. Bezier curve defined by the following equation:

$$V(t) = \sum_{i=0}^{n} V_i B_{i,n}(t) \quad (1)$$

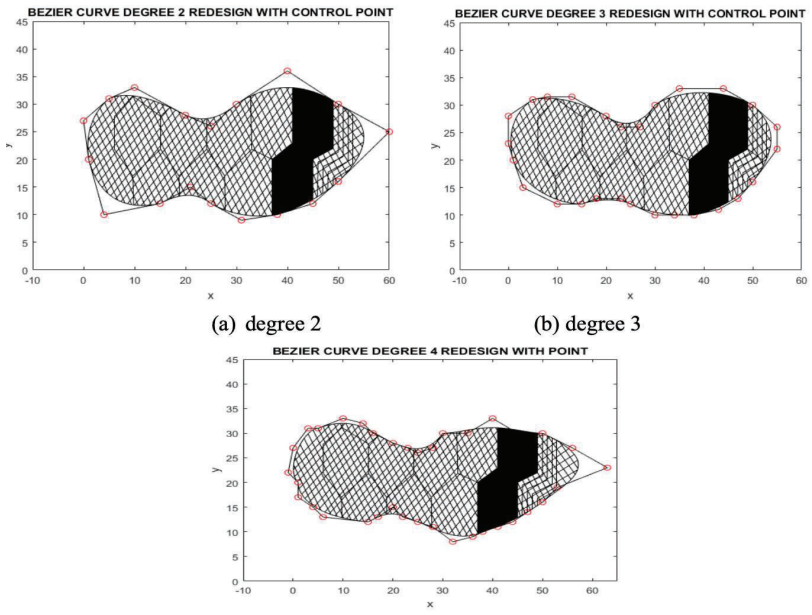
where, the basis functions for Bezier curve are;

$$B_i^n(t) = (n\,i)t^i(1-t)^{n-i} \quad (2)$$

And where $(n\,i)$ designate the well-known binomial coefficient function or binomial distribution from probability and statistics; $(n\,i) = \frac{n!}{i!(n-i)!}$.

Results and Discussions

The results were evaluated by using MATLAB software. Table 1 shows the different generation of Bezier curves for degree 2, 3 and 4.



(a) degree 2 (b) degree 3

(c) degree 4

Figure 2: Comparison generation of degree for Bezier curves

Table 1 shows elapsed time taken of original design of shoe sole using Bezier curve for each degree with control point. From Table 1, we can conclude that the Bezier curve of degree two takes the shortest time to produce the image which is 2.11 seconds while the highest time taken is the Bezier curve of degree 4 which is 2.46 seconds. This concludes that as the degree increases, the computation time is increased.

Table 1: Elapsed time taken of original design of shoe sole by using Bezier curve

	Bezier curve		
Degree	2	3	4
Number of curves	9	9	9
Number of lines	115	114	114
Elapsed time (seconds)	2.11	2.34	2.46

References

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