

UNIVERSITI TEKNOLOGI MARA

**DESIGNING A HIGH-PRECISION
GEOGRAPHICAL MAP OF
TERENGGANU USING CUBIC
TRIGONOMETRIC B-SPLINE AND
CUBIC TRIGONOMETRIC BEZIER**

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ABSTRACT

This study aims at creating a precise two-dimensional map of Terengganu by utilizing Cubic Trigonometric B-Spline (CTBS) and Cubic Trigonometric Bézier (CT-Bézier) which belong to a class of Computer-Aided Geometric Design (CAGD). The investigation uses the issue of the lack of precision in traditional methods of mapping, particularly with regard to when complex geographical attributes are represented. To overcome this, both CTBS and CT- Bézier were used since they are flexible with shape control and can provide smooth curves based on shape parameters. The primary goals of the project were to model the Terengganu map with the two techniques, find out the most appropriate shape parameters to make sure the curves are smooth and also find the most appropriate technique to provide accurate geographical modelling. The data collection involved the extraction of map outlines in Google Maps and 498 control points were located on the Terengganu boundary. These points were applied in Mathematica software to design curves with the help of CTBS and CT- Bézier basis functions. Some of the chosen values of the shape parameters were the following, $\eta \in (\frac{1}{2}, 2]$ in the cases of CTBS and $m \in [1,2]$ in the cases of CT-Bézier in order to have a smoother or an accurate representation of the curves and how such parameters would influence each. The shoelace formula also referred as the Gauss area formula was used to estimate and compare the calculated area with the actual area of the Terengganu map. The findings indicated that both methods were able to create the desired shape, although the CT- Bézier, especially with shape parameter $m = 0.1$, resulted in the most realistic and smooth curve and produced area value that was nearest to that of the original map. Graphical comparisons also showed that CT- Bézier curves were much close to the control polygon with better control and transition being smoother. In contrast, the CTBS curves had slight deviations even with the increased values of the shape parameters with the highest output when the shape parameter is $\eta = 2$. Consequently, this study has reached a conclusion that CT-Bézier technique is more reliable and efficient method suitable for creating detailed and precise maps. All three research objectives were able to be reached.

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