

A Bezier Curve Optimization Method Based on Segmentation Factor (t) for Path Planning in Autonomous Navigation

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Abstract. Path planning plays a major role in autonomous navigation. Different curve fitting methods are used in creating path for autonomous vehicles. Among those Bezier curves are widely used to create path especially in roundabouts due to their special properties. The primary factor that affects the shape and curvature of the Bezier curve is the control points. Researchers have established equations for finding the control points of a Bezier curve passing through selected points. The two critical elements that determine the control points are the random points selected for control point calculation and the segmentation factor (t) for each of the points selected. The values of segmentation factor (t) is assigned randomly to each point. As the segmentation factor change new control points are calculated which makes a change in the shape of the curve but the curve will pass through the selected points. So, this paper presents the change in the shape of the curve as the segmentation factor (t) changes. Additionally it demonstrates the change in segmentation factor (t) for each point selected to fit the curve within the required space and to adjust t value for connecting two different Bezier curves to create a single curve with continuous curvature. This paper also presents an equation for finding the t value for each of the points selected to avoid overfitting and underfitting of the curve.

INTRODUCTION

In fields like kinematics, graphics, engineering various sorts of curves are employed. A significant subgroup of curves is Bezier curves. Bezier curves are used in different applications such as computer-aided design, graphics, path planning, etc [1]–[4]. Path planning plays a major role in autonomous navigation. Different path planning methods are used to create path for the vehicle to follow. Among those Bezier curve based path planning is used to generate path in roundabouts and other kinds of intersections as the shape of the curve can be adjusted easily by adjusting the control points of the curve

A roundabout is a special intersection where traffic moves only in one direction. Roundabouts can reduce the congestion related to traffic lights by replacing the conventional intersection and increasing the flow of traffic [5]. Path planning is complex in a roundabout due to its shape. Different curve fitting methods are used for planning the path to overcome the complexity. In [6]-[7], clothoid-based curve fitting methods were used by the authors to create a path. In the case of a clothoid curve, the curvature depends on the length of the curve, that is, as the length increases, the curvature also increases. However, when the path length is too small the curve won't fit within the available space due to high curvature. So to overcome that some other authors [1], [8]–[10] have used the Bezier curve-based curve fitting method to create a path so that the shape of the curve can be adjusted according to the roundabout