Minimizing Highway Alignment Cost by Optimizing Horizontal Curve Radius

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Abstract

In practice, the task of designing the horizontal alignment of a highway is done manually based on experience and engineering judgement. As a result, the work is both time and resource consuming and relies heavily on human expertise. This paper presents a general formulation for optimization of horizontal alignment, composed of tangential segments and circular curves. It consists of a constrained optimization problem where the objective function is to minimize the overall cost of the horizontal alignment. These constraints are imposed by curvatures, geometric guidelines, the presence of inaccessible regions, etc. In addition to construction costs, facts considered by this model also include highway geometric code requirements. The paper mainly focuses on fitting the curves with appropriate radius between the tangential sections obtained by connecting the optimum set of point of intersections (PIs). The available methods consider radius of the curves as a constant value, which also acts as a constraint while developing an optimal alignment. Application of the model to a real-world study area is also presented in this paper, along with a comparative study with AutoCAD Civil-3D.

Keywords: Geometric design, Horizontal alignment, Horizontal radius, Sequential Quadratic Optimization, Non-linear optimization

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