Title Curvature and Maximum Permissible Speeds

Description In this activity students will compute the curvature of a section of commuter rail and use it to determine a safe speed at which a train should can round the corner without tipping or derailing. The shape of the track is specified as a large table of discrete coordinates rather than as a curve in closed form, which necessitates the use of a computer for numerically approximating the maximum curvature of the track.

This activity is meant for use in a typical multivariate calculus course, during the coverage of arc length and curvature. It is meant to demonstrate a practical, real-world application of the graphical concept of curvature to transportation engineering, as well as giving the students some experience in working numerically with a function defined as a data table rather than being able to analytically evaluate derivatives by hand like they would in class.

Learning Outcomes After this project, students should be able to:

- Explain why the graphical concept of curvature is important in some engineering applications.
- Numerically approximate basic calculus quantities (like derivatives) for a function consisting of a table of discrete values.
- Use a programming language or spreadsheet software to organize and process a large data set.

Handouts and Resources This module includes the following documents:

- Instructor notes (`pdf`)
- Student handout (`pdf`)
- Data table (`tsv`)
- Source files (`zip`)

Tags calculus, functions, data analysis, numerical approximation, engineering, transportation

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