# Students Get Behind the Wheel of Vehicle Dynamics

Firsthand Data Collection Modules for Engineering Students

## TRANSPORTATION CURRICULUM

## THE MODULES

### LATERAL ACCELERATION

Based upon the Oregon Department of Transportation horizontal curve evaluation procedure for recommended advisory speeds. Digital ball-bank indicators record values to evaluate how fast a horizontal curve can be safely negotiated.

### LONGITUDINAL DECELERATION

Smartphones and/or iPods are mounted to a vehicle dashboard. The driver accelerates to a predetermined speed, which is maintained briefly before beginning braking at a set location. Applications on the smartphone and/or iPod are used to collect the data

### SERVES BOTH GRADUATE & UNDERGRADUATE

Undergraduate students evaluate low-speed curves on roads around campus and test longitudinal deceleration in a single three-hour period. Students in the graduate level course evaluate curves across the city and test longitudinal deceleration in two separate three-hour periods.

## WHY IT'S IMPORTANT FOR STUDENTS

Currently, civil engineering students study vehicle operating dynamics from the textbook and thus may not fully appreciate how these accelerations/decelerations "feel" to drivers, the ultimate consumers of their engineering designs. The collection of data in the field will allow undergraduates to establish the connection between the design world and "real" world. The analysis of these data will allow students to implement the design principles learned from the textbook and make design decisions or evaluations using the obtained data.

*Curriculum developed by Roger Lindgren, PhD, Oregon Institute of Technology*

NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

Improving the mobility of people and goods to build strong communities

### TARGET AUDIENCE

Undergraduate students in an introductory transportation engineering course; Graduate students in an advanced engineering course such as Geometric Design of Roadways.

### TIME FRAME

Graduate level, two three-hour lab sessions. Undergraduate level, one three-hour lab session.

### INSTRUCTOR EXPERTISE

Expertise in the collection and management of smartphone/iPod acceleration data.

### STUDENT EXPERTISE

Ability to drive, ability to use a smartphone/iPod for data collection.

This research was supported by the National Institute of Transportation and Communities (NITC)

# MATERIALS LIST

## LATERAL ACCELERATION

- Laptop with at least 2 USB ports
- Ball Banking Equipment Kit
- Velcro strips for mounting inclinometer to dashboard
- A working vehicle and licensed driver

## LONGITUDINAL DECELERATION

- iSeismometer app, available for iPhone and Android
- Bubble Level app, available for iPhone and Android
- Velcro for mounting phone to vehicle dashboard
- A working vehicle and licensed driver

# LESSON PLAN OUTLINE

## COMPLETE LESSON PLANS AND VISUAL AIDS ARE AVAILABLE IN THE FINAL REPORT

- Divide students into teams of 2—a driver and a data recorder
- Set up car with data collecting equipment
- Drive curves or test stops according to instructions
- Collect and record data
- Compute averages for each curve, speed and direction back in the computer lab

# LEARNING OBJECTIVES

- Determine whether or not the AASHTO recommended value for deceleration of braking vehicles (11.2 ft/s2 ) is still viable given recent advancements in vehicle technology.
- Explore design concepts and make independent engineering judgements
- Collect data in uncontrolled environment with no "right answers"

# UNIQUE ASPECTS

It may be beneficial to bring in a professional guest lecturer. When this course was taught at the Oregon Institute of Technology, Eric Leaming, Traffic Devices Engineer for the Oregon Department of Transportation, was invited to demonstrate the ODOT horizontal curve evaluation procedure to the graduate class.

The National Institute for Transportation and Communities (NITC) is one of five U.S. Department of Transportation national university transportation centers. Housed at Portland State University, NITC is a program of the Transportation Research and Education Center (TREC). This research partnership also includes the University of Oregon, Oregon Institute of Technology, University of Utah, University of Arizona, and University of Texas at Arlington. We pursue our theme through research, education, and technology transfer.