ROADWAY SAFETY INSTITUTE

Advancing roadway safety with user-centered solutions

UTC Project Information	
Project Title	Novel Collision-Avoidance System for Bicycles
University	University of Minnesota
Principal Investigator	Rajesh Rajamani
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Funding Source(s) and Amounts Provided (by each agency or organization)	Roadway Safety Institute (USDOT): $210,000 Roadway Safety Institute-Office of the Dean, College of Science & Engineering: $24,464 Roadway Safety Institute-Office of the Vice President for Research: $30,234
Total Project Cost	$264,698
Agency ID or Contract Number	UTC Grant Number: DTRT13-G-UTC35 CTS# 2015020
Start and End Dates	5/1/2014 – 2/28/2018
Brief Description of Research Project	*Final report abstract:* This project focuses on development of a sensing and estimation system for a bicycle to accurately detect and track vehicles for two types of car-bicycle collisions. The two types of collisions considered are collisions from rear vehicles and collisions from right-turning vehicles at a traffic intersection. The collision detection system on a bicycle is required to be inexpensive, small and lightweight. Sensors that meet these constraints are utilized.To monitor side vehicles and detect danger from a right-turning car, a custom sonar sensor is developed. It consists of one ultrasonic transmitter and two receivers from which both the lateral distance and the orientation of the car can be obtained. A Kalman Filter-based vehicle tracking system that utilizes this custom sonar sensor is developed and implemented. Experimental results show that it can reliably differentiate between straight driving and turning cars. A warning can be provided in time to prevent a collision. For tracking rear vehicles, an inexpensive single-beam laser sensor is mounted on a rotationally controlled platform. The rotational orientation of the laser sensor needs to be actively controlled in real-time in order to continue to focus on a rear vehicle, as the vehicle's lateral and longitudinal distances change. This tracking problem requires controlling the real-time angular position of the laser sensor without knowing the future trajectory of the vehicle. The challenge is addressed using a novel receding horizon framework for active control and an interacting multiple model framework for estimation. The features and benefits of this active sensing system are illustrated first using simulation results. Then, extensive experimental results are presented using an instrumented bicycle to show the performance of the system in detecting and tracking rear vehicles during both straight and turning maneuvers.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	One direct result of this project is a nearly $1 million grant from the National Science Foundation, secured by Rajamani and RSI director Max Donath. This "Partnerships for Innovation: Building Innovation Capacity" grant awards funding to academe-industry partnerships whose proposals move research toward implementation. In this new project, Rajamani and Donath will partner with Quality Bicycle Products (QBP) to develop, test, and potentially commercialize a bicycle sensor that can monitor nearby vehicles on the road and detect the possibility of an imminent bicycle–car collision.
Impacts/Benefits of Implementation (actual, not anticipated)	*No data to report.*
Web Links • Reports • Project website	http://www.roadwaysafety.umn.edu/research/search/projectdetail.html?id=2015020 http://www.roadwaysafety.umn.edu/publications/researchreports/reportdetail.html?id=2684