Surtrac for the People: Upgrading the Surtrac Pittsburgh Deployment to Incorporate Pedestrian Friendly Extensions and Remote Monitoring Advances

With research funding from the Traffic21 Institute's Mobility21 University Transportation Center Program, Dr. Stephen Smith, Director of the Intelligent Coordination and Logistics Laboratory at Carnegie Mellon University, developed the Scalable Urban Traffic Control (Surtrac), the world's first decentralized smart adaptive traffic signal system. This system significantly improves traffic throughput, trip delays and pollution along congested roads controlled by traffic lights. The system applies artificial intelligence to traffic signals equipped with cameras or radars adapting in real-time to dynamic traffic patterns of complex urban grids, experienced in neighborhoods like East Liberty in the City of Pittsburgh. Dr. Smith worked with the City of Pittsburgh, Southwestern Pennsylvania Commission (regional MPO), Pennsylvania Department of Transportation (PennDOT), University of Pittsburgh Medical Center, and neighborhood groups on a pilot deployment of Surtrac, which resulted in a 40% reduction in vehicle wait time and a 20% reduction in emissions. The original deployment of nine intersections in 2012 has expanded to 50 intersections and is now funded by the U.S. Department of Transportation (USDOT)'s Advanced Transportation Congestion Management Technology Deployment (ATCMTD), and PennDOT grants for an additional 150 intersections in Pittsburgh. With two patents from the UTC research, Dr. Smith's Pittsburgh-based company Rapid Flow Technologies has created eight jobs and currently has commercial deployments in Atlanta, GA; Portland, ME and Needham and Quincy MA.

While many regions pursued more closed test tracks, Traffic21 focused on growing deployments using the city streets of Pittsburgh as our real-world connected and automated vehicle testbed. In 2014, the Surtrac deployment was expanded with 25 intersections with Dedicated Short Range Communications (DSRC) radios. This deployment was part of the USDOT-affiliated test bed system of connected vehicle research. At that time, it was the second largest deployment behind the 2012 Safety Pilot in Ann Arbor, MI.
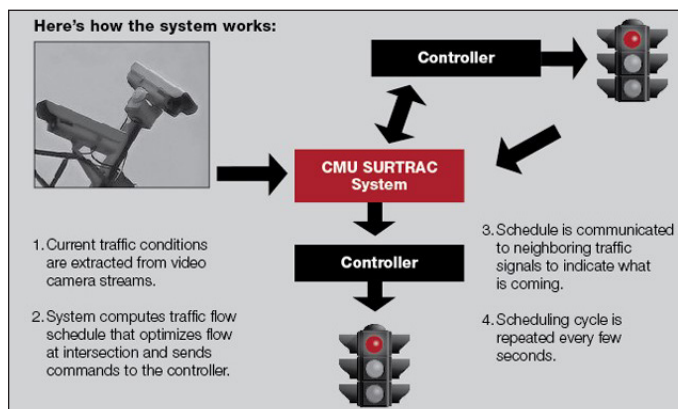
Surtrac Adaptive Traffic Signal System

Carnegie Mellon University

The USDOT ATCMTD grant of $11 million ($29 million total with City and PennDOT match) will expand this early connected vehicle test bed by 150 intersections. This ATCMTD grant was predicated by the City of Pittsburgh's finalist proposals to the USDOT Smart City Challenge, where Traffic21 was the lead partner. Current efforts are underway to expand this real-world and connected test bed to include broader advanced wireless and smart city technology and research. Through early success of this transportation research, development and deployment, the Traffic21 model was applied to a broader swath of smart city applications for Pittsburgh. Thus, Metro21 was born in 2015 and in 2017 its vision was embodied in the Open Platform wirEless Research Accelerator (OPERA), which was a finalist for a National Science Foundation Platforms for Advanced Wireless Research (PAWR) grant. With the support of Traffic21, Metro21 has applied for the second round of PAWR and $20 million in funding. OPERA builds directly on top of the existing connected vehicle test bed, applying advanced wireless technologies for other smart city applications. Surtrac provides the basis for this continually expanding test bed.

Dr. Smith thinking about where the next deployment of Surtrac can be implemented.

Expected project outputs include preparation of the Surtrac network for new technologies, e.g., pedestrian detection capability, and for further expansion of the system. This includes development of new algorithms for software applications and installation/ integration of software at signalized intersections. Furthermore, this project will conduct an assessment of those upgrades of the coordination of traffic signals with pedestrian walk signals, predictive modeling of traffic flows from detector information, improved mobility for all system users and overall traffic flow optimization. This awarding-winning research has received wide exposure through webinars and national media coverage. Surtrac continues to be the core of significant testbed projects including OPERA and City's Smart Spines ATCMTD deployment. The Surtrac Pittsburgh deployment itself doubled in size to 50 intersections during the 2014-2018 phase of Traffic21, and will grow by 300% through the ATCMTD grant.

Partnering with the City of Pittsburgh and Rapid Flow Technologies (the commercial provider of the Surtrac smart signal system), researchers will upgrade and assess the Surtrac Pittsburgh deployment to include new coordination of traffic signals with pedestrian walk signals and assess the upgrade to determine the impact on pedestrian crossing time at intersections, predictive modeling of traffic flows from detector information, and overall traffic flow optimization. Surtrac has also grown in scope to include equipping Port Authority of Allegheny County (PA) buses with DSRC and testing two way communications between traffic signals and blind pedestrians through a $2 million Federal Highway Administration Accessible Transportation Technologies Initiative (ATTRI) grant.

Dr. Smith shares his experience and an overview of the Surtrac Adaptive Traffic Signal System to CTAA Conference Attendees in June 2018.

The integration of new pedestrian detection capabilities to exploit vehicle-to-infrastructure communication for smart transit priority and other vehicle expediting services, and provide pedestrians with disabilities improved technology for safe intersection crossing will be explored. The goal is to allow for enhancement of the existing technology to make intersections safer, incorporate pedestrians with varying abilities and needs, and improve vehicle throughput.

About This Project

CMU Traffic21 Institute's first USDOT University Transportation Center, Technologies for Safe and Efficient Transportation was awarded grants under both MAP-21 and SAFETEA-LU. Then in 2016, we were awarded a 3rd UTC under the FAST ACT, called the Mobility21 National University Transportation Center, focusing on improving mobility of people and goods. Professor Raj Rajkumar serves as the director of Mobility21. University partners include the University of Pennsylvania, the Ohio State University and the Community College of Allegheny County. Learn more about Mobility21 on our website, mobility21.cmu.edu.

This newsletter highlights some recent accomplishments and products from one University Transportation Center. The views presented are those of the authors and not necessarily the views of the Office of the Assistant Secretary for Research and Technology or the U.S. Department of Transportation.

Printed on paper containing recycled post consumer waste paper.