The T-SET
National University Transportation Center on Safety

Prof. Raj Rajkumar, T-SET UTC Director
The T-SET UTC

• A consortium of Carnegie Mellon and Penn

• The T-SET University Transportation Center aims to study, build and deploy an integrated suite of complementary technologies and policies to make surface transportation safer and more efficient.
The Vision and High-Level Approach

- Deployment
- Information and Communication Technologies
- Zero Transportation Fatalities and High Efficiency
- Sensing and Actuation Technologies
- Transfer

Technologies for Safe and Efficient Transportation
Overall Thrusts

- In-Vehicle Technologies
- Infrastructure Technologies
- Connected Vehicle Technologies
- Vehicle Automation
- Mobility Analytics
Societal and Economic Benefits

• Fewer accidents, fatalities and injuries

• Higher throughput (less traffic congestion)
  – Continually evolving technology to improve infrastructure
  – Lower maintenance costs
  – Support for multi-modal transit
  – Sound technical basis for policy-making

• Higher economic productivity
• Better quality of life.
Project Categories

• In-Vehicle Safety Technologies
• Infrastructure Technologies for Safety
• Connected Vehicle Safety Technologies
• Vehicle Automation
• Mobility Analytics
Key UTC Pieces

- Deployments
- Workforce Dev.
- Partnerships
- Advisors
- Research
- Education
Faculty & Leadership

CMU Faculty Members
- Jacobo Bielak (CEE)
- Bernardine Dias (Robotics)
- John Dolan (Robotics)
- Jim Garrett (CEE)
- Martial Hebert (Robotics)
- Chris Hendrickson (CEE)
- H-J Kim (Robotics)
- Christoph Mertz (Robotics)
- Srinivas Narasimhan (Robotics)
- Hae Young Noh (CEE)
- Andre Platzer (CS)
- Sean Qian (Heinz College)
- Raj Rajkumar (ECE, Robotics, CyLab)
- Aaron Steinfeld (Robotics)

Penn Faculty Members
- Prof. Rahul Mangharam (ESE)
- Prof. Jianbo Shi (CIS)
- Kostas Danillidis (CIS)
- John Landis (Design)
- Prof. Insup Lee (CIS)
- Prof. C.J. Taylor (CIS)
- Prof. Vijay Kumar (MechE and CIS)

Executive Leadership
- Chris Hendrickson, Director, Traffic 21
- Al Biehler, Executive Director
- Stan Caldwell, Dep. Exec. Director
- Rick Stafford, Director, Traffic 21
- Courtney Ehrlichmann, Project Mgr
- Mark West@ Penn

~20 graduate students (mostly Ph.D.)
Penn Schools and Centers

GRASP Laboratory
General Robotics, Automation, Sensing & Perception

PRECISE (Penn Research in Embedded Computing and Integrated Systems)

PennDesign

National University Transportation Center on Safety
UPenn Projects

[Images of various projects related to transportation safety and technology]
Adaptive Traffic Signals

Objective
– Demonstrate ability of adaptive signalization approach

Benefits
– to improve traffic flow and reduce air pollutants in urban road networks

Test Site
– Developing area with changing traffic patterns and volumes
– 9 recently upgraded intersections (controllers and cameras)

Current Status
– CPUs and network that run the system are installed at each intersection and system test trials are ready to commence
– “Before” traffic flow analysis is complete
– Simulation results comparing system with current timing plans are promising:

<table>
<thead>
<tr>
<th>% Reduction</th>
<th>Travel Time</th>
<th>Wait Time</th>
<th>Emissions</th>
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<tbody>
<tr>
<td>AM rush</td>
<td>37%</td>
<td>63%</td>
<td>32%</td>
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<tr>
<td>PM rush</td>
<td>23%</td>
<td>42%</td>
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Sponsors and Partners:
– Heinz Endowments (Breathe.org)
– City of Pittsburgh
– Traffic Control Products, Inc.
– Traficon Traffic Video Detection
V2I Infrastructure near Pittsburgh

- **Cranberry Township**, PA
- Located 20 miles north of Pittsburgh, PA
- 1.8 mile stretch along Rt. 19 corridor
- 11 intersections are instrumented
Planned Traffic Light V2I Testbed in Pittsburgh

- 23 traffic lights near UPMC Shadyside Hospital, Shadyside, Pittsburgh
- Part of **adaptive traffic signals** project
  - Extension from East Liberty/Bakery Square neighborhood
- **Summer 2014**
Bridge Monitoring

**Leads:**
Prof. Jim Garrett (CEE), Prof. J. Bielak (CEE), J. Kovacevic (BME)

**Objective:** Develop an approach that takes the acceleration data that comes from many vehicles passing over a bridge to determine if changes to bridge have occurred.
Continuous Road Surface Distress Detection

**Lead:**
Dr. Christoph Mertz, Robotics

Mount a structure light sensor (cost ~$1k, resolution ~1mm) on vehicles that regularly traverse the road network.

Analysis of the data gives an assessment of the current state of the road surface (potholes, cracks etc.)

(A) Image of the damaged road. (B) One road cross-section. (C) Several cross sections combined to form a 3D map of the road. (D) Map with medium (yellow) and severe (red) road distress.
Autonomous Rides in Pittsburgh and DC
## Consortium

<table>
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<tr>
<th>Consortium Partners</th>
<th>City of Philadelphia</th>
<th>PITT OHIO Express</th>
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<tr>
<td>AASHTO</td>
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<td>Access Transportation Systems</td>
<td>City of Pittsburgh</td>
<td>Philadelphia Port Authority</td>
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<tr>
<td>Accessible Transportation &amp; Workforce Interagency Cooperative</td>
<td>Community College of Allegheny County</td>
<td>Pittsburgh Technology Council</td>
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<td>ALCO Parking</td>
<td>Conference of Minority Transportation Officials</td>
<td>Port Authority of Allegheny County</td>
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<td>Allegheny Conference on Community Development</td>
<td>Delaware River Port Authority</td>
<td>Port of Pittsburgh Commission</td>
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<td>Allegheny County</td>
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<td>Southeastern Pennsylvania Transportation Authority</td>
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<td>APTA</td>
<td>General Motors Global Research &amp; Development</td>
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<td>Beth’s Barricades</td>
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<td>Booz Allen Hamilton</td>
<td>Open Roads</td>
<td>University of Pittsburgh</td>
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<tr>
<td>Bosch Research &amp; Technology Center</td>
<td>PennDOT</td>
<td>Women’s Transportation Seminar</td>
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Pennsylvania Motor Truck Association
Education and Technology Transfer

- Faculty Seminar Series
- Webinars
- Consortium
- Partner with Center for Innovation and Entrepreneurship at CMU
- Non-traditional, interdisciplinary approach to educating tomorrow’s transportation professionals

Domains
- Civil & Environmental
- Electrical & Computer Engineering
- Robotics
- Computer Science
- Mechanical Engineering
- Public Policy
Thank you.