Mercedes “Hard to Imagine” Commercial. I watch little TV, but I am pleased that Mercedes continues to hit prime spots with this ground-breaking commercial. NBC had it right after the running of the Kentucky Derby and it aired several times in the New York market during the Rangers Playoff games. They must be seeing traction.

Uncongested Mobility for All: NJ’s Area-wide aTaxi System

This year my students and I have been conducting a quantitative assessment of the mobility implications of the ultimate in Smart Driving Cars. The task was simple: How well could a truly safe fleet of self-driving cars serve the full spectrum of personal mobility needs.

While the availability of such a fleet is yet more than a few years away, we assumed that the spatial and temporal aspects of children going to school, adults to work and the array of normal lifestyle activities would remain unchanged as they tend to occur on a typical weekday throughout New Jersey. We chose New Jersey, not only for local reasons, but also because, to the possible chagrin of some, New Jersey is actually a microcosm of the nation. It has an extremely rural South and Northwest, sprawling suburbs in Central and Coastal and dense old and new urbanism in Northeast Jersey. It is served by an extensive commuter rail network yet the overwhelming majority of vehicular trips are currently served by the personal automobile. On a typical day, New Jersey Transit serves 0.9 of the 32 million trips (2.8%) while walking and biking serve 2.3 million trips (7.3%). The remaining 90% are served by the personal automobile.

By “safe” we assumed a vehicle technology that is sufficiently reliable to yield at least the safety benefits touted for the Google car: 71% fewer accidents, 65% fewer injuries, 81% fewer fatalities. While very substantial, these safety enhancements are somewhat conservative, given the often repeated: “… 93% of automobile accidents involve human error” and the 2001 NHTSA report by Hendricks et al: “...In 717 of the 723 crashes investigated (99%), a driver behavioral error caused or contributed to the crash. Of the 1284 drivers involved in these crashes, 732 drivers (57%) contributed in some way to the cause of their crash. ...six causal factors...accounted for most of the problem behaviors:
driver inattention 22.7%, vehicle speed 18.7%, alcohol impairment 18.2% perceptual errors (looked, but didn’t see) 15.1%, decision errors 10.1%, incapacitation (fell asleep) 6.4 %...” (p ii). Consequently, by adopting the Google values, we are implicitly assuming that the Smart Driving Technology, while very good, is itself realistically not perfectly safe.

With respect to the operation of the fleet, assumed was that one or more fleet owner-operator(s) would emerge to provide the service. These owner-operators could be either public, not-for-profit or for-profit private operators. They would be responsible for the provision, operation and maintenance of the fleet of self-driving vehicles. A level-of-service would be offered that is comparable to conventional taxi services, except that no human driver would be involved in neither any passenger trip nor the repositioning of empty vehicles. Consequently, we’ve named the system an autonomous taxi (aTaxi) system.

Fare collection was put aside as irrelevant by the assumption that the level-of-service would be so compelling that essentially all “vehicular” trips would be served in some way by the aTaxi system. The enhanced mobility implications of the aTaxi system are assumed to dominate any negative utility implications of how the system is financed. This allowed us to sidestep the non-trivial mode choice issue and enable us to address and ascertain the mobility implications of a very high-quality full-blown aTaxi system.

To properly assess the aTaxi system’s ability to serve essentially all trips, it is imperative to appropriately characterize each and every trip taken on a typical day. This was accomplished through the enhancement of an Individual Daily Trip Synthesizer (IDTS) (Mufti, Gao). IDTS begins with Census Block data and builds a file representing each of the nearly 9 million New Jersians characterized in the 2010 Census. Using the Journey-to-Work Census file, an additional 263,000 individuals are added to represent out-of-state residents that work in New Jersey. Each of these 9,054,821 individuals is assigned demographic characteristics such as age, gender, household size, family income, etc. that when assembled reflect the distribution of these demographic characteristics reported in the Census Block Data. The corresponding Census Block centroid gives their home location to within a very short walk. To make the file a little more social, first and last names were assigned probabilistically to each individual from White Pages name-address files.

Based on an individual’s demographic characteristics, a daily trip tour is assigned that begins and eventually ends at home. The very young, the very old, the sick and those incarcerated in prisons don’t travel. The rest go to school, to work and/or to other activities throughout the day according to the trip maker’s demographic characteristics and school, employment and other activities files, each of which contain precise geographic location (geo-coded street address) and trip attraction characteristics such as employment levels, enrollments, and daily patrons. Each trip is assigned a departure time (in seconds from midnight) based on the trip type and the operational characteristics of the dominating trip end. For example, each school and employer has a starting and ending “bell” time along with a parameter that characterizes the punctuality of the operation. Behavioral aspects, such as students tend to arrive early at school rather than late and few depart early, more late, are modeled in the non-symmetric probabilities used in assigning trip departure times.

The result of the trip synthesizing effort is the creation of a file containing the precise spatial and temporal values for each of more than 32 million trips. In total, these trips are representative of the desired mobility of all who travel in New Jersey on a typical weekday. Characteristics of one such realization of the trip synthesizer were reported by Gao.

Given the 32 million trips, the question becomes how well does an aTaxi system serve such trips?

First, some trips are extremely short. Short trips, less than a mile in length (~7.3%), are taken by either walking or biking. Also, New Jersey has an excellent commuter rail system. Trips from/to New York City, Philadelphia and within a ¼ mile...
walk to a train station are assumed to use NJ Transit rail for at least a portion of the trip. Each of these trips takes NJ Transit to/from the other trip end’s nearest station with an aTaxi “multi-modal” segment completing the trip. The departure time of the non-NJ_Transit segment is set to the appropriate train arrival, thus replicating the temporal bunching of onward trips following train arrivals.

In total, the analysis described above leave almost 30 million trips that are to be served by the fleet of aTaxis on a typical day. The 2\textsuperscript{nd} part of this series will describe aTaxi service scenarios, similar to elevator services, that accommodates naturally occurring ride sharing opportunities. Taking advantage of these basically eliminates all congestion in New Jersey without the need for any infrastructure expansions. The 3\textsuperscript{rd} part of the series will describe the commensurate environmental and safety implications.

******************************************************************************

Calendar of Upcoming Events:

Stanford University, Palo Alto, CA Transportation Research Board’s premier multidisciplinary research and policy conference focused on Road Vehicle Automation. If you are actively involved in road vehicle automation and would like to actively contribute to the success of this conference by becoming a patron or sponsoring one of the meals, please contact me at alaink@princeton.edu.

June 26-28, Gold Coast, Australia

June 11-12, Detroit MI

******************************************************************************

Smart Driving Cars
Thursday, May 2, 2013

******************************************************************************

Smart Driving Cars
Friday, April 25, 2013

Mercedes is 1\textsuperscript{st} Mover and Lifts Bar with ‘14 Mercedes E-Class Safety Features
Supported by the following TV Commercials (If you haven’t seen them on TV they are worth watching

http://www.youtube.com/watch?v=C3elSidnchM http://www.youtube.com/watch?v=Hr-vxprjMVE

From the Public Sector: My response to the US DoT on Surface Transportation System Automation (http://orfe.princeton.edu/~alaink/SmartDrivingCars/Kornhauser_%20Response2AutomationRfI.pdf

******************************************************************************
The Business Case for SmartDrivingCars: For the consumer, SmartDrivingCars have three main values: increased safety, comfort and convenience. Of these safety is most easily quantified because damages are largely adjudicated in monetary terms. AAA estimates that traffic fatalities and injuries amounted to $256B in 2011, or a cost of about $1,328 in '05 dollars for each licensed driver. Of this amount approximately 50% ($664) is paid by private insurance, the pass-through portion of insurance premiums. Individual crash victims absorb 26% ($185), the Federal treasury absorbs 6% ($80) and local municipalities 4% ($50). Google’s simulation of the operation of its self-driving car on the range of real crash scenarios resulted in a forecast of 81% fewer fatalities and 65% fewer injuries. This substantial reduction in car crashes would save in the US $183 billion annually. Moreover, these safety improvements would be enjoyed proportionally by each owner/user of a Google car. Thus, the insurer of the average licensed driver switching to a “Google car” could expect to reduce its pass-through liabilities by an average of $475 per year. Since these are simply pass-through dollars, one could expect that an insurance price-leader might readily offer discounts of up to, say, $450, keeping the expected remaining $25 for its “generosity”. The Google car user would also forgo $247 in expected “deductible self-insured” obligations.

The $450 insurance discount could readily finance, if not the expensive Google “lildars”, the lower cost radars and cameras contemplated by the auto industry for its initial wave of automated lane keeping and “always-on” collision monitoring and avoidance systems. For example, the Mercedes “jam-assist” system is expected to be available on 2014 models as a $3,000 “driver assistance safety option”. While jam-assist doesn’t have all of the features of a Google car, it may be able to capture as much as two-thirds of the safety benefits through the collisions that jam-assist can be expected to avoid during the car’s lifetime. If so proven, then the $300 discount that Flo, or the Gecko, or Good Hands or the General or some other insuer can readily offer would essentially finance this $3,000 safety feature. In fact Flo should escort you to the Mercedes dealer and pay for the option if you agree to buy a Mercedes and continue your current policy payments. (Remember, in giving Mercedes $300 per year over say 12 years, she is also keeping that $25 “generosity” for her effort, so she is happy.) In addition to substantially reducing the probability that this car is going to kill you, what’s in it for you? Well, how about the two-thirds of the $247 self-insurance expected obligation that you would avoid each year. More importantly you get the anxiety-relief that flows from having driving assistance while traveling in some of the most tedious, boring and unpleasant roadway conditions. Finally, society wins because we can’t really place a value on the injuries and fatalities that will be prevented. They are priceless!

Going all the way with Google Cars (or even just two thirds of the way with “jam-assist”) would mean for New Jersey an annual avoidance of 500 (340) fatalities and 28,000 (19,000) injuries “valued” at $3.55 ($2.38) Billion per year.

We MUST make this happen. Everybody wins.
European Update: Workshop: Automation in Road Transport (contains links to participants & presentations)

As background if you haven’t read it: from June 29, 2011: **Definition of necessary vehicle and infrastructure systems for Automated Driving** Final report SMART 2010/0064

************************************************

**Smart Driving Cars**
Monday, March 11, 2013

Best videos from Workshop: Automation in Road Transport (contains links to participants & presentations)

Automated Steering Avoidance of imminent collision on Frozen Lake done Feb 23, 2013. Videos of automated collision avoidance maneuvers involving only steering followed by Volvo Platooning video

************************************************

**Smart Driving Cars**
Monday, March 4, 2013

Continental and BMW Group Working Together to Develop Freeway-Grade Highly Automated Driving

*BMW Press Release*

*Continental Press Release*

This is BIG, not only because they have “an agreement to jointly develop an electronic co-pilot for this purpose”, but because...

- It aligns a component supplier with a manufacturer. Where does this leave Daimler and VW/Audi? To join up with Bosch? What about Delphi? Join back with GM on this one?? Where does this leave the other manufacturers; will they align? The competitive race to attract consumers to the showroom has really heated up.
- They’ve realized that safety is now clothed in comfort & convenience. Together, they make a powerful message to the car buying public. This technology will draw people into the showrooms. The wake-up call was delivered by the emergent competitor, Google, rather than government edicts or rule-makings. “…[I]n capitalist reality…, it is not [price] competition which counts but the competition from the new commodity, the new technology…- competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.” *Joseph A Shumpeter* (1883-1950)

************************************************

**Smart Driving Cars**
Thursday, February 28, 2013

*This is BIG!!!*

Smart Driving Cars
Alain L. Kornhauser, PhD
Professor, Operations Research & Financial Engineering
Director, Transportation Program
Faculty Chair, Princeton Autonomous Vehicle Engineering
229 Sherrerd Hall
Princeton University
Princeton, NJ
alaink@princeton.edu