

Automotive Cyber-Physical Systems

Speaker: Prof. Rahul Mangharam, University of Pennsylvania



Highlight: Automotive-CPS networks are a special class of networked Cyber-Physical Systems where the maximum relative speeds are in excess of 80m/s, the node density can span over 9,000 vehicles/mi² and, most importantly, the dynamics of the vehicle, the environment, driver reaction and interaction with other vehicles need to be considered in every communication and control decision. The automobile of the future will be networked for network-based active safety and real-time traffic congestion probing and prediction. To realize this goal, we present three contributions toward the foundations of Automotive-CPS: (a) GrooveNet - a vehicle-to-vehicle network virtualization platform that enables communication between hundreds of virtual vehicles and real vehicles on the same street map and using the same communication protocols and network algorithms. GrooveNet facilitates the design, deployment and evaluation of vehicle-to-vehicle and vehicle-to-infrastructure protocols for both time-critical and safety-critical Automotive-CPS applications. (b) Bounded Latency Broadcast Protocols for multi-hop communication of safety alerts for active networked safety and (c) AutoMatrix - a GPU-based vehicular traffic congestion simulator that can simulate over 5 million networked vehicles for real-time traffic congestion probing and prediction. Given these building blocks, we believe that Automotive-CPS wireless networks will make driving safer, more efficient and of course, more enjoyable.

Dr. Rahul Mangharam is the Stephen J Angello Chair and Assistant Professor in the Dept. of Electrical and Systems Engineering, with a secondary appointment in the Dept. of Computer and Information Systems, at the University of Pennsylvania. His interests are in real-time scheduling algorithms for wireless and embedded systems with applications in vehicular-to-vehicle networking, medical sensor networks and industrial control networks.

He received his Ph.D. in Electrical & Computer Engineering from Carnegie Mellon University where he also received his MS and BS. in Electrical & Computer Engineering in 2007, 2002 and 2000 respectively. In 2002, he was a member of technical staff in the Ultra-Wide Band Wireless Group at Intel Labs. He was an international scholar in the Wireless Systems Group at IMEC, Belgium in 2003. He has worked on ASIC chip design at Marconi Communications (1999) and Gigabit Ethernet at Apple Computer Inc. (2000). He was a visiting researcher at Athens Institute of Technology, Greece in the summer of 2006.