UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

"Sensor Systems for Autonomous Vehicles"

Prof. Sergio Saponara

Department of Information Engineering, University of Pisa – Italy

With the Guest Lecture of

Dr. Fabrizio Gagliardi

Barcelona SuperComputing Centre, Spain

EU-ACM Europe Chair, Switzerland

Short Abstract:

The tutorial will focus on recent advances in sensors, circuits and systems for new generations of vehicles, with driver-assisted/autonomous capability, and smart mobility systems. The social and economic impact of the smart transportation field is huge since every year 90 millions of vehicles are sold worldwide and 1.25 millions of people are killed due to lack of safety. In US 3.1 billions of gallons of fuel are wasted each year due to traffic congestion. Assisted driving, and in the next future autonomous driving, will increase safety, and will enable intelligent management of traffic flows. Key enabling technologies for this scenario are advanced sensors (including Radar, camera, Lidar and inertial sensors), and relevant acquisition and signal processing systems, V2X (vehicle to everything) communication, and on-bard sensor fusion in real-time and with high functional safety levels. During the first day, the course will host the Guest lecture of **Dr. Fabrizio Gagliardi** entitled "Considerations on Machine-Learned Automated Decision Making".

Course Contents in brief:

The tutorial will be divided in 4 parts.

In Part 1 innovation and market trends in the field of electronics and ICT (Information and Communication Technology), applied to new generations of vehicles and mobility systems, will be discussed. Automotive operating requirements in terms of ESD (ElectroStaticDischarge), temperature range, over-voltage/current protection and integrated diagnostic, will be discussed too.

In Part 2 real-time acquisition and processing circuits/systems for advanced sensors, including Radar and Lidar, will be presented. These sensors aim at detecting if there are obstacles around the vehicle, and at measuring their distance, relative speeds, and directions.

Part 3 of the tutorial will focus on vision sensors, organized as an array of video cameras operating in visible or infrared spectrum. The problem of reducing the distortions caused by the adoption of large Field of View fish eye lens will be also discussed. Some applications to traffic sign recognition

systems, road signs recognition, image mosaicking for all around view during parking assistance, will be discussed.

Part 4 will discuss examples of driver assistance/autonomous navigation by using data fusion, i.e. integrating information coming from Radar and Lidar and video camera sensors, or from on-board MEMS inertial sensors, or acquired through V2X wireless systems (like satellite positioning/navigation or IEEE 802.11p vehicular networks).

During the first day, the course will host the Guest lecture of Dr. Fabrizio Gagliardi entitled "Considerations on Machine-Learned Automated Decision Making".

Total # of hours: 16 (4 Credits)

References:

[1] S. Saponara, G. Ciarpi, "IC design and measurement of an inductorless 48V DC/DC converter in low-cost CMOS technology facing harsh environments", IEEE Transactions on Circuits and Systems I, 2017

[2] F. Pieri, C. Zambelli, A. Nannini, P. Olivo, S. Saponara, "Consumer electronics is redesigning our cars? Challenges of integrated technologies for sensing, computing and storage", IEEE Consumer Magazine 2017

[3] S. Saponara, B. Neri, "Radar sensor signal acquisition and multi-dimensional FFT processing for surveillance applications in transport systems", IEEE Transactions on Instrumentation and Measurement, 2017

[4] S. Saponara, F. Giannetti, B. Neri, G. Anastasi, "Exploiting mm-Wave Communications to Boost the Performance of Industrial Wireless Networks", IEEE Transactions on Industrial Informatics, 2017

[5] S. Saponara, P. Tisserand, P. Chassard, Dieu My Ton, "Design and Measurement of Integrated Converters for Belt-driven Starter-generator in 48 V Micro/mild Hybrid Vehicles", IEEE Transactions on Industry Applications, 2017

[6] S. Saponara, "Hardware accelerator IP cores for real-time Radar and camera-based ADAS", Journal of Real-Time Image Processing 2016

[7] S. Saponara, B. Neri, "Design of compact and low-power X-band Radar for mobility surveillance applications", Computers and Electrical Engineering, 2016

[8] S. Saponara, E. Ragonese, M. Greco, B. Neri, G. Palmisano, "Highly integrated low-power radars", 255 pages, Artech Publishing House, 2014

[9] M. Turturici, S. Saponara et al., "Fish-eye lens distortion correction", Journal of Real Time Image Processing 2014

[10] S. Genovesi, A. Monorchio, S. Saponara, "Compact triple-frequency antenna for subGHZ wireless communications" IEEE Antennas and Wireless propagation Letters, 2012

CV of Prof. Sergio Saponara

Sergio Saponara is Full Professor of Electronics at University of Pisa where he is responsible for the courses of "Vehicular Electronics", "Electronic Systems for Automation and Robotics", "PCB Electronics Design". He is also the responsible of the course "Electronics" at the Italian naval Academy in Livorno, of the IEEE CAS Summer School 2017 "Enabling technologies for IoT" and he is co-founder of the Master in Automotive Engineering and Principles of Management, Universities of Florence and Pisa. He is IEEE Distinguished Lecturer and co-founder of the IEEE Special Interest Groups in IoT of the CAS and SP societies. He co-authored about 300 scientific publications (more than 200 indexed in Scopus or Isl WoS) and he is chief technical officer of Ingeniars srl.

Room and Schedule

16 hours

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule: 12nd, 14th, 15th February 2018

12nd February – 9 am to 12 am and 2 pm to 4 pm Prof. S. Saponara, 12 am to 1 pm Dr. F. Gagliardi

14th February – 9 am to 2 pm Prof. S. Saponara

15th February – 9 am to 2 pm Prof. S. Saponara