



UNIVERSITÀ DI PISA  
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE  
Dottorato di Ricerca in Ingegneria dell'Informazione

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Doctoral Course

**“Recent Advances in Sensors and Embedded Systems for Automotive ADAS (Autonomous Driver Assistance Systems)”**

Prof. Sergio Saponara, Dip. Ingegneria della Informazione, Università di Pisa

**Short Abstract:** The course will focus on recent advances in electronics and ICT (Information Communication Technology) for Autonomous Driver Assistance Systems in new vehicle generations. Sensing technologies and HW-SW embedded systems (architecture, including mm-wave transceivers and antennas, and algorithm) for parking assistance, enhanced driver vision, collision avoidance, cruise control, tyre condition monitoring, will be discussed. To this aim, recent state of art in video- and radar-based systems will be reviewed. Automotive and railway example applications will be provided.

**Course Contents in brief:**

- Introduction: Research trends in Electronics and ICT for Autonomous Driver Assistance Systems in new vehicle generations
- Video-based systems for ADAS: visible and infrared cameras for vehicles, fish-eye lens for large field of view cameras, real-time HW-SW solutions (architecture and algorithms) for video mosaicking (all-around view in parking assistance), cameras distortion correction, image enhancement in bad light conditions, automatic recognition of road and traffic signs
- Automotive radars for ADAS: radar vs. LIDAR or video-camera systems, specifications for Short-range and Long-range automotive radars, FMCW radar, architecture partitioning (Radar mm-wave front-end and antenna, HW/SW platforms for Radar signal acquisition and processing), examples of automotive and railway radar transceivers at 10 GHz, 24 GHz and 77 GHz
- Tyre monitoring: smart sensors for tyre monitoring (pressure, temperature, acceleration), wireless tyre monitoring (transceiver front-end and sub-GHz antenna, microcontroller-base processing platform)
- Final course evaluation

**Total # of hours:** 15

**References:**

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

- [2] S. Saponara, E. Bellers, G. de Haan, G. Ramponi, "Guest editorial – Special Issue on Algorithms and Architectures for Real-Time Image and Video Enhancement", Journal of Real Time Image Processing 2013
- [3] M. Turturici, S. Saponara et al., "Fish-eye lens distortion correction", Journal of Real Time Image Processing 2014
- [4] S. Saponara, R. Cassettari, L. Fanucci, M. Righetto, P. Ruggiero, "Networked Radar System to Increase Safety of Urban Railroad Crossing", IEEE ICSUTE 2015
- [5] S. Genovesi, A. Monorchio, S. Saponara, "Compact triple-frequency antenna for sub-GHz wireless communications" IEEE Antennas and Wireless propagation Letters, vol. 11, pp.14-17, 2012
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## CV of the Teacher

Prof. Sergio Saponara, IEEE Senior Member, got Master and PhD degrees in Electronic Engineering from University of Pisa. In 2002 he was a Marie Curie Research fellow at the Inter-university-Microelectronics Center (IMEC), Leuven, Belgium. He is enrolled as Associate Professor and he has got the Italian National Scientific Habilitation to the role of Full Professor of Electronics. He teaches courses of Vehicular Electronics, Electronic Systems for Robotics, Embedded Systems at Pisa University for the Master degrees in Electronic Engineering, Vehicle Engineering, Robotics and Automation Engineering. He also teaches Electronics at the Italian Naval Academy in Livorno. He is associate editor of the Springer Journal of Real-Time Image Processing and of IEEE/IET Electronics Letters. He is member of 2 IEEE standardization activities, of the Technical committees TC-7 and TC-19 of the IEEE Instrumentation and Measurement Society, he served in the organization of several IEEE and SPIE Conferences and as guest editor of special issues in several ISI journals. He served as member of the reviewing board of several IEEE, IET, Elsevier and Springer journals. He held plenary/invited talks at IEEE and SPIE conferences, including IEEE RADARCON 2012. His research interests include embedded computing engineering, integrated electronics and applied electronic systems. He co-authored more than 200 scientific publications and 10 patents and wrote a book on low-power radars. He is the co-founder of IngeniArs srl, a start-up company, spin-off of the University of Pisa. His technology transfer activity includes collaborations with STMicroelectronics, Renesas, Selex, Ericsson, Piaggio, Magna, AustriaMicroSystems, CAEN, Sitael, Intecs, Rico, Flyby. He served as project manager or WP manager in several national and international research projects (PRIN, FIRB, POR-CREO, ESA, INFN, FP6, FP7,..). He is associate member of INFN and CNIT. He joined the NEWCOM and HIPEAC EU networks of excellence.

## Room and Schedule

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

Schedule: 3 days as follows:

July 11, 2016 – 14.30 to 18.30

July 12, 2016 – 9.00 to 13.30

July 13, 2016 – 9.00 to 13.30, 14.30-16 final exam