



DIPARTIMENTO DI INGEGNERIA DELL'ENERGIA ELETTRICA  
E DELL'INFORMAZIONE "GUGLIELMO MARCONI"

**Short Course on:**

## **RADAR technologies in automotive**



**Scuola di Ingegneria e Architettura – Università di Bologna**

**Aula 4.2 - March 29, 2019, h. 09:00 - 16:00**

**Instructors: Holger H. Meinel, Marlene Harter**

Automotive radars are in production and on our roads since 1998 and recently the production numbers have exploded, due to the improvements in technologies which allowed the integration of Radar-on-chip at millimeter-waves. Therefore, Millimeter-wave Radar found its way to a mass-market solution in automotive Radar, as well as in various industrial and consumer applications. Particularly driven by the advance of the Internet of Things (IoT), autonomously driving cars and Industry 4.0, the amount of radar sensors and their networks is fast growing, promising radar chipsets to reach the mass volume market. At this time there are at least 180 million automotive radar-sensors operating on our streets worldwide.

This short course will cover the full range of the design considerations of radar applications at mm-wave frequencies starting from EM propagation aspects to automotive radar system design and architecture to the final target applications. The course is co-constructed by two outstanding speakers in the field of automotive RADAR who have developed their carriers in both the industry and the Academia.

The course is primarily constructed to be benefitted by the master students in **Advanced Automotive Electronic Engineering**, but master and PhD students from the **Telecommunication, Electronics, and Automation** fields are also welcome!

**9.00-9.15** Introduction – **A. Costanzo and R. Rovatti**

**9.15-10.45** “RADAR at millimeter waves and the specifics of wave propagation (line-of-sight, whether dependencies, etc.) in this wavelength area” – **M. Harter**

**11.00-12.30** “The history of car RADAR applications since the 1970s until today (LRR- to SRR- and BSD applications)” – **H. Meinel**

**12.30-13.45** lunch break

**14.00-15.00** “RADAR modulation as of today, system architectures up to SoC approach” – **M. Harter**

**15.00-16.00** “Future trends of Advanced Driver Assistance Systems (ADAS) sensors, e.g. L2/3 vs. L4/5 (sensors in production and future sensor requirements)” – **H. Meinel**

**Organizers:** Prof. Alessandra Costanzo (alessandra.costanzo@unibo.it), Prof. Riccardo Rovatti (riccardo.rovatti@unibo.it),

ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA

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## CVs of the instructor:

### Marlene Harter

Marlene Harter received the Dipl.-Ing. (M.S.E.E.) degree in electrical engineering from the Universität Karlsruhe (TH), Germany in 2008. In cooperation with Siemens AG in Munich and the Institute of Radio Frequency Engineering and Electronics at the Karlsruhe Institute of Technology she worked towards her Dr.-Ing. (Ph.D.) degree, which she received in 2014. In 2014 she joined Robert Bosch GmbH in the division of driver assistance systems in Leonberg, Germany. First, she worked in the radar customer interface group, where she was in charge of vehicle integration and testing of 77 GHz radar systems. Later on she managed the platform development for the next generation side and corner radars. In October 2018, she became professor at the Offenburg University of Applied Sciences in Germany. Her research interests are in radar system design and concepts for automotive, industrial and medical applications.

### Holger H. Meinel

Holger H. Meinel joined the AEG-TELEFUNKEN Advanced Technology Department in Ulm, Germany, in 1973 after graduating with a Diploma in Microwave Engineering from the RWTH AACHEN in Aachen, Germany. He started to design mm-wave components, among others for a 35 GHz collision avoidance radar. Never changing company but only their names over about 40 years, he switched his location and role of work nearly every 5 years. However, working in the US or France in the 1980s, and again the US in the 1990s he normally was located in Germany. Coming full circle in his career, from May 2010 to December 2012 he has been responsible for external contacts of Daimler AG within the EU-Project MOSARIM (More Safety for All by Radar Interference Mitigation); thus finally coming back-to-his-roots again: ACC radar for cars.

Holger H. Meinel is author and co-author of over 175 technical papers, mostly on millimeter-wave integration and application. He holds or has held 14 patents and among other things has been involved in key-functions with the European Microwave Association (EuMA). During the restructuring of the European Microwave Conference (EuMC) from 1996 to 1998 he served in the newly founded Steering Committee, and became one of the 6 founder members of EuMA. He especially fostered application oriented contributions to EuMW, as well as he supported and enhanced the student involvement in EuMA. In 2011 – during the EuMW in Manchester, UK, - he was awarded with the EuMA Distinguished Service Award for his lifelong contributions to the microwave community.

Since September 2014 he officially is in retirement. Besides being active as an independent ADAS consultant for different international companies and institutions, he has been actively involved in different conferences and events, concerning automotive radar and autonomous driving, such as: EuMW, from Rome (Oct. 2014), via Paris (Sept. 2015), London (Oct. 2016), Nuremberg (Oct. 2017), to Madrid (Sept. 2018); or IMS 2016 in San Francisco, CA, and IMS 2017 in Honolulu, HI, USA. Besides others: the 2<sup>nd</sup> Forum on Intelligent Vehicles in Chengdu, China (Oct. 2015) and 10<sup>th</sup>, 11<sup>th</sup>, 12<sup>th</sup> Virtual Vehicle Conf. in 2017/ 2018/ 2019, respectively, taking place in Graz, AT; Recently, in February **2019**, he was be the general chairman of the 2<sup>nd</sup> International VDI-Wissensforum Conference 2019 on Automotive Sensor Systems in Munich, Germany - as he was in 2018.

In January 2015 Holger H. Meinel was appointed by the EuMA BOD to be the speaker of the EuRaMIG (European Radio and Microwave Interest Group), one of three core groups within EuMA, for 3 years. EuRaMIG being the body to hold contact with the EU-Commission for EuMA on behalf of innovative technology related EU calls. In 2018 he was re-appointed.