Course Description

Course name	**#064 - LiDAR Sensors from System to Transistor/Device Level and Miniaturization through ASIC and (Co-)Packaging**
Duration	**5 days**
Format	**Public Classroom, Inhouse Event and Online**

Overview

Dr. Farzad Parsaie, founder of SAND Microsystems GmbH, Switzerland is teaching this 5-day course on LiDAR Sensors**.**

LiDAR, that stands for Light Detection and Ranging or simply Light Radar, has already been known for decades and used in different areas like meteorology and space. Recently more attention and interest has been devoted to LiDAR to detect objects for plenty of new applications such as autonomous driving (AD), advanced driver assistance systems (ADAS), drones, robots, 3D Imaging and scanning, etc.

However, the conventional LiDAR instruments in use have been quite bulky and very expensive. This has strongly limited the usage of this sensor so far. Over 100 companies are working on the development of new LiDAR solutions that can be used for many product applications mentioned above.

This course enables Engineers and Managers to become familiar with different concepts that a LiDAR sensor can be realized from the top system level down to the transistor and device level. It is planned to raise the awareness of the participants about the challenges and the development issues of LiDAR by proposing several solutions that can help to minimize the development risks and time.

After introduction and comparison of architectures details of Electronic and Optoelectronic components and subsystems will be covered. Advanced techniques and technologies will be introduced that enable us to minimize the size and cost of LiDAR tremendously.

Technical Focus

LiDAR is a sensor that measures distance with light and can be used to detect obstacles for vehicles and robots or to scan buildings.

Over 100 companies are working to develop LiDAR solutions that can bring the required high performance and are more economic in terms of costs and much smaller for better integration in vehicles, robots, and drones so that they can be easily portable.

Course Content

This course provides an overview of different LiDAR architectures in their use cases. Examples are Time of Flight (ToF) and FMCW techniques, where light can be scanned over the scene or illuminate the whole field of view with a flash.

The advantages and challenges of each case will be discussed in detail. The course will focus from System level to Transistor and Device level on all Electronic and Optoelectronic components and subsystems. Advanced discrete and integrated techniques and technologies like Analog/RF-Frontend topologies, Discriminator, ADC, ASIC process technology (CMOS, BiCMOS), (Co-) Packaging, different devices like Photodetectors and Laser Diodes as well as switches, switch drivers and power management techniques will be addressed extensively.

Solutions for miniaturization of novel LiDAR products through ASIC integration and (Co-) packaging will be shown with the goal of how to reduce costs and improving performance.

Who Should Attend
This is a course about the development of LiDAR as a multi-disciplinary product, hence of interest for technical staff of different disciplines. They need to understand details and consider optimization on a higher product level and not only locally on a single discipline level.

It will be of interest to:

- Engineers, Physicists, Optics Experts, Scientists, Technical Staff, and Students
- System Architects, Project Managers, Technical Managers, and Functional Safety Managers involved in the design, implementation, and optimization of intelligent and safety-critical systems.
- Business Development Managers and Marketing Managers are involved in the specification, development, or commercialization of intelligent and safety-critical optoelectronic products aiming for rapid Time to Market.

Course Daily Schedule

Day 1

Overview LiDAR and Architectures

- Introduction LiDAR
- Time of Flight (ToF) LiDAR, Flash and scanning LiDAR
- AMCW, FMCW, FM Comb LiDAR
- What is a solid-state LiDAR?
- Light wavelength and Power, Eye Safety

Day 2

The Optical Receive Channel

Part1: Photodetectors

- Introduction of discrete and integrated Photodetectors

- Physical Principles and Technologies
- Light power and wavelength sensitivity, materials
- Noise sources, sensitivity, and speed

Day 3

The Optical Receive Channel

Part2: Electronic Interface and Signal Conditioning

- Low noise and high-speed electronic Interfacing of Photodetectors
- Discrimination topologies
- Topologies for Analog to Digital Converters (ADC) and Time to Digital Converters (TDC)
- Discrete (with off-the-shelf components) and integrated (ASIC) Realization
- ASIC Integration Technologies and Challenges

Day 4

The Transmit Channel

- Introduction of Light Sources
- Laser Diode Control Electronics
- Introduction and principles of Switch Components
- Switch Driver Electronics and the parasitics to be minimized
- EMC issues, Integration and Miniaturization

Day 5

Light Steering Methods, Power Management and Packaging

- MEMS Mirrors for Light Steering (technology, challenges, sensing and control electronics, ASIC)
- Optical Phased Arrays (OPA) and the role of Silicon Photonics
- Power Management Topologies for LiDAR (discrete and integrated)
- Electronic and Optoelectronic (Co-)Packaging and Hybrid Assembly

Instructor Biography

Mr. Farzad Parsaie, founder of SAND Microsystems GmbH, Switzerland, is an experienced engineer and entrepreneur working for more than 25 years in the area of Semiconductors and Sensor research and development. In his work he focuses primarily on MEMS/Sensor and Photonic Products (such as Optical Sensors and LiDAR).

Dr. Parsaie previously worked at the Institute of Microelectronics from Technical University Berlin, Philips Semiconductors AG, NXP Semiconductors AG, ams AG and Elesta GmbH. He has been in charge of CMOS Analog/Mixed-Signal and RF Design, Optoelectronics, MEMS interfacing and industrial sensors from feasibility study and development to industrialization with strong focus on miniaturization through ASIC and (Co-)Packaging. As an expert in different areas he has worked with several leading semiconductor and product companies as customers and contributed to minimize their development risks and cost.

Dr. Parsaie has been a member of the Continuing Education Institute-Europe faculty since 2020.