11. Photonic Technologies for Communication, Sensing, and Displays

Course Leaders: Torsten Wipiejewski, **Huawei Technologies**

Course Description:

This course will provide an overview on the various photonic technologies that enable optical communication, optical sensing, and modern display applications. These applications are key for the information and communication technology of today and path a way to the future. High speed optical communication from board level in data centers to long haul transmission requires photonic components with high speed and high reliability. We will discuss the main components such as laser diodes of several types, high speed optical modulators and photodetectors as well as integration schemes such as photonic integrated circuits PICs and packaging aspects. Photonic technologies are also widely used as sensors for various applications including health monitoring. One key advantage is the potential for non-invasive measurements that facilitates the usage by end-users without specific medical knowledge. Packaging should provide high accuracy solution at low cost. Displays are the main media nowadays for bringing information to people. They range in size from smart watches to smart phones, laptops and tablets all the way to large screen TVs and video walls. We review current technologies and new developments such as quantum dots and micro-LEDs as well as some features of 3D displays. Micro-LEDs for large size displays require novel assembly technologies to mount chips of only several micrometers in size with extremely high yield at very low cost. The mass transfer of thousands of chips simultaneously is an option to achieve this challenging target.

Course Outline:

1. Fundamental properties of photonic components
2. Light sources (LEDs, laser diodes, others)
3. Transmitter and receiver components in optical communication (lasers, modulators, photodetectors, passive optical components, photonic integrated circuits PICs, silicon photonics, optical modules), monolithic and hybrid integration, packaging.
4. Optical sensing elements and applications (spectrometers, light sources, photoacoustic sensors, frequency combs)
5. Display technologies (liquid crystal displays LCD, organic light emitting diode OLED displays, quantum dot emissive layers, micro-LED arrays and large size displays using chiplet mass transfer and bonding, 3D displays)
6. Summary and outlook

Who Should Attend: The course addresses engineers, scientists and students who would like to get a general overview of various photonics technologies used in today's products and future developments. The aim is to describe which photonic technologies can be used in various applications and what current limitations are and which new technologies are being developed for further improvements or aiming at technology break throughs.

Dr. Torsten Wipiejewski joined Huawei Technologies in 2014 and is responsible for the European technology sourcing of Huawei's Hardware Engineering Institute. His interest covers all hardware aspects for products ranging from smart watches to optical communication systems. He has also been appointed as Technical Advisor to the President of Huawei's European Research Institute. Previously, Torsten was an investor in renewable energy, CEO at Optogan (Germany, Finland) making blue LEDs, and COO at Firecomms (Ireland) making optical

transceivers for automotive applications. He also held management positions at ASTRI in Hong Kong, Agility Communications in Santa Barbara, CA, USA as well as Infineon, Osram, and Siemens in Germany. Torsten received a “summa cum laude” Ph.D. degree in electrical engineering from the University of Ulm, Germany and has been an executive member of several international conferences. He was the General Chair of ECTC 2008 and has lectured several courses at conferences and universities. He holds more than 30 patents and has published over 100 scientific papers and presentations.