

Optics at COM

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At COM we welcome this opportunity to present some of our research in optics. It is our hope that this will be of interest to our colleagues in the optics community and further promote collaborations in optics and related areas.

COM in a nutshell

COM is a research and education center affiliated with the Technical University of Denmark. The activities at our center all have scopes that fall under one headline, namely *Telecommunication*. That is, the common denominator through all of our projects is the acquisition of knowledge and technology that will be of value for the present and future developments of this transport machine.

The research at COM contributes to the developments of many aspects of modern telecommunication. In fact, we cover the whole value-chain from research in materials and components, that go into optical communication systems, over network architecture and management, to services and applications in the telenet and the regulation of these. In other words, we take up many aspects of the construction of the communication transport layer and the access to this, as well as the use and control of the telecommunication systems.

The role of optics

Optics is today a vital part of telecommunication systems. Traditionally the systems solely used electrical signals for telephony and data transport. However, today we see a mixture of electrical and optical signals, and the use of optics is rapidly increasing. This mainly due to that the optical signals (carrier frequencies of ~100 THz) are transmitted in guiding fibers with very little loss. This is not the case for the electrical equivalents where carrier frequencies will have to be kept below a few GHz to avoid too much impedance in the copper wires used for transmission. This means that the optical signals – capable of transmitting at higher bit-rates – are superior for transmission of large amounts of data over long distances. And there is a serious need for this as the demand for capacity, or bandwidth, overall doubles every 9 months! The ways of solving this are either the use of even higher bit-rates, mixing of different data signals in time (Time-Division-Multiplexing), mixing of data signals carried by different optical wavelengths (Wavelength-Division-Multiplexing), or indeed a combination of these. This in turn puts stronger demands on the optical fibers transmitting the accumulated data signals. Pushing these limits is a research topic in itself. Equally important is the generation of the fast and stable optical signal transmitters. When it comes to handling of the optical signals in the network nodes, e.g. distribution points, components that can perform operations purely on the optical level are highly desirable, as no conversion to electrical signals is needed. However this is far from the case in networking today. The operations needed in

the nodes are often so sophisticated, that the inconvenience of converting the optical signals to electrical ones is easily superseded by the very advanced functions, that electronics can offer. And one should not forget that the access part of the networks is substantially dominated by electrical data transmission, whether it is (mobile-) telephony or data transfer from and to computers. The optics supplements the electronics, and vice versa – it is this interplay that takes the networking to a higher level.

From research to products

Our main tasks are within the longer-term strategic research alongside the education of the telecom engineers of today and of tomorrow. However, we do also emphasize industrial deployment of our developed technologies and findings, once these are brought towards the level where commercialization is a realistic next step. To promote this, we engage in much collaboration with industrial partners that further develop parts of our technology platforms into products. On the Danish scene there is a substantial number of companies with focus on optical technologies, components and systems. These include Tellabs Denmark, GN Nettet, Lucent Technologies Denmark, IONAS, Giga (now Intel), ADC Denmark, Crystal Fibre and CISILIAS (the latter two being direct spin-off companies from COM). All of these have part, or indeed all, of their technology base coming out of our scientific environment. Furthermore, we enjoy seeing new ‘bubbling’ companies like HYMITE adding to this strong optical companies’ cluster here in Denmark.

The question naturally comes up, whether this strong industrial cluster within optical technologies for telecommunication is an indication of the research being fully exhausted. The answer is a clear *no!* It is instead an indication that this is an area with much potential. There is plenty of research to be done, and new land to be gained – for many, many years to come!

Facts about COM

- 125 members of staff, including 45 Ph.D. students
- 50 Masters project students per year

Research areas

Services and applications

- Economy, markets and regulation
- Multimedia
- Computer Supported Cooperative Work

Transmission and networks

- Networks
- Systems
- Coding and modulation

Photonics

- Optoelectronics
- Glass components and materials

Publications in 2000

- Journal papers: 125
- Conference papers: 150
- Patent applications: 12

More information

www.com.dtu.dk