

# Photonics is Everywhere!

Photonics is a key enabling technology that can be found everywhere. Photonics is not part of your everyday language, but it serves as the foundation for many technologies we depend on daily, including those that use light, create light, detect light, or modify light. From its beginnings with the invention of the laser in the 1960s, photonics technologies have advanced significantly to impact a wide range of sectors, especially the following: telecoms and data communications, healthcare, advanced manufacturing, automotive, environment and energy, food and agriculture, and aerospace, security and defense, and more.

**Carlos Lee**, Director General, EPIC – European Photonics Industry Consortium.

## Food and Agriculture

Photonics is used heavily in agriculture today. It is hard to imagine precision agriculture without the help of sensors and cameras on tractors and drones to enable soil and crop analysis and to determine areas requiring application of fertilizers. Photonics are also applied to forecast the perfect time to harvest crops. Combined with machine vision equipment, photonics can be used in sorting fruits. Lighting in agriculture also plays a big role in supporting the growth of city farming. With the use of LED lighting, vegetables and fruits can be grown in vertical farms to provide fresh and clean food to urbanites. Food safety can be likewise ensured with photonics technologies. Spectroscopy is employed to detect contaminants in vegetables and other agricultural products before they reach the consumer's table.



## Healthcare

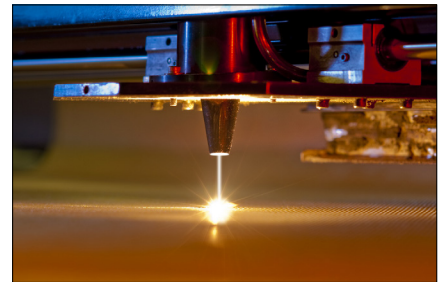


New applications of photonics in the medical field are truly revolutionary. Developments in photonics can facilitate more precise detection of diseases. Imaging technology and laser and light therapy, for instance, can be combined together

to detect earlier and prevent serious diseases like cancer. Photonics applications can also minimize the number of days of hospitalization and improve treatment regimen for patients. Because light is non-invasive, procedures that require needle pricking and surgery can be eliminated. Blood sugar level, for example, can now be analyzed by just looking through the skin and without using a needle. Photonics is today used mainstream in laser-eye surgery and, in the near future, will make it possible to restore blindness. Recent developments in photonics likewise holds promising potential for prevention of contagious diseases. Photonics technologies can be vital in ensuring a malaria-free world. The combination of a laser and a camera could technically be utilized to recognize a mosquito and shoot it down with a laser! And with the help of photovoltaic panels on a camel, a fridge can be powered and permit the transport of life-saving medicine into remote areas in the desert.

## Advanced Manufacturing

Laser technology has been a key in paving the way for automation in the manufacturing sector. With laser light devices, products can now be produced with better quality and in a more environmentally friendly manner. The flexibility of laser devices have also sustained the ever-increasing trend of product customization, especially in consumer electronic products like smartphones, digital cameras, smart televisions, and video game consoles. Photonics technologies have also become vital in manufacturing semiconductors. Without optical lithography technology, it would not be possible to mass-produce semiconductor chips. Photonics have also become indispensable in epoxy resin curing, control and monitoring of chemical production, machine vision, optical technologies for inspection, and other advanced manufacturing processes.



## Telecoms and Datacoms

The backbone of today's internet infrastructure is wholly dependent on fiber optic technology, which in turn is enabled by photonics. The internet travels through optical fibers made of glass thinner than a hair; they transfer information from one part of the globe to the other at the speed of light. Without optics and fibers, it would be impossible to send emails, search on Google, connect through Facebook, and it would be impossible to transfer pictures, music and video the way we do it today. And the trend follows on, since, as predicted by Cisco, in 2019 80% of the global internet consumption will be video content, resulting in every second nearly a million minutes of video will be streamed over the internet. Photonics has indeed paved the way for connecting not only homes but businesses, institutions, and research equipment and infrastructures, an advancement that has enabled improvement of education, work, services and security. In a world that is becoming more and



more connected, it is therefore not surprising that one of the main focuses is the development of photonics systems and photonics integrated circuits that are essential to faster, cheaper, and more efficient internet systems.

## Automotive

In the automotive industry, photonics technologies start off by playing a part in the industrial manufacturing process. High power lasers are used to cut metal, weld metal, and perform metal marking processes. With 3D printing technology, lasers are used to cut textile, such as the airbag, in the car. Photonics technologies have also made it possible for manufacturers to possibly come up with the car of the future. Driver-less cars have previously existed only in the fertile and imaginative minds of futurists. With the significant innovation in photonics technologies in the past few years, the automotive industry has now found ways to develop autonomous vehicles. Photonics is also responsible for the development of smart vehicle technologies. From sensors that can detect environmental changes and communication systems between various devices inside and outside vehicles, to advanced systems of lighting to accentuate the vehicle's interior and exterior and night vision cameras that enable the driver to see in the dark, photonics technologies today play a vital role in ensuring road safety.



## Aerospace, Security and Defense

The role of photonics in the advancement of aerospace technology is immeasurable. With micro and nano photonics systems, spacecraft can not only travel farther into space but can also be controlled remotely upon landing onto planets and other extraterrestrial bodies. Optic technologies can be further refined to help astronomers to employ far more sophisticated telescopes that can see further in space. Photonics will also play an important role in the security and defense industry. Currently, photonics systems are indispensable in airport security, biometric identity management systems, border surveillance, and defense communications systems. Advancement of photonics technologies is also significant in producing smart weapons systems that enable the military to enhance national security and defense. For instance, cutting-edge sensors enable the production of unmanned aerial vehicles that can be remotely controlled to discretely carry out sensitive missions. Recent innovation in photonics have also made it possible to impose stricter security measures and processes. For instance, textiles with displays that illuminate so they are more visible. Light indicators can also be built directly into carpets in hotels for directions in case of fire. Police has been using photonics technologies



for many years for the analysis of fingerprints in a crime scene and, in the future, with sensors that use the properties of light, police can identify in a moving car if the driver has been drinking alcohol and reduce potential accidents or crimes. Photonics technologies are also used to analyze paintings to check for other paintings and drawings that are hidden behind, to see previous versions and sketches, helping to detect fraud and forgery. Lastly, ink can be visually inspected on documents to see if someone has been cheating on that check!

## Environment and Energy

Lowering our carbon footprint and finding renewable sources of energy is critical in fighting climate change. Fortunately, photonics is on our side in this matter too. Photovoltaic systems made up of semiconducting materials capture solar energy from the sun and

convert it to clean electricity. Photovoltaic cells on a car could be used to power a fan to keep the car cool when it is parked in the searing heat. Photovoltaic systems can also be used to power a drone which can be kept flying in the air with the help of a laser to recharge it. Photonics can likewise be instrumental in finding ways to optimize consumption of non-renewable energy. For instance, fuel consumption can be maximized by utilizing photonics-based thermal insulation and diagnostics systems. Photonics technologies are also important in maintaining a safe and green environment. Optical systems, for example, can be used to analyze water, air and soil quality. Fibers can be employed to measure oil composition and in bridges or nuclear reactors to measure the structure of the building for safety purposes. Solid state lighting such as LED can provide mercury-free lighting to illuminate homes without posing harm to the environment.



## Conclusion

Photonics technologies are amazing, fascinating, and you find them really everywhere. It is hard to imagine living life as we know it today without photonics. Photonics makes the quality of our lives way better, and more exciting! It safeguards our health and ensures that we consume safe and nutritious food. Photonics fuels manufacturing and drives the growth of the economy without harming the environment. Lastly, it is difficult to imagine a safe and secured world without the help of photonics technologies. And because photonics is a key enabling technology, it is unimaginable to think a future without photonics. Indeed, photonics is a technology with a very, very bright future and EPIC is proud that its members around the world play a key role in the advancement of this important and fascinating technology.

## About the Author

Carlos Lee is director general at EPIC, Europe's photonics industry association. As part of the EPIC mission, Carlos works closely with industrial photonic companies to ensure a vibrant and competitive ecosystem by maintaining a strong network and acting as a catalyst and facilitator for technological and commercial advancement. He brings with him a strong background in microelectronics which was acquired through several management positions held at the international association SEMI. He has been responsible in Europe for the SEMI International Standards program, managed technical and executive programs, and together with the advisory board advocated for a more competitive semiconductor and photovoltaic manufacturing industry. Carlos has a BBA in Finance and an MBA in Leadership & Change Management from United Business Institutes. He lives with his spouse and three children in Belgium.



**Carlos Lee**  
Director General, EPIC  
European Photonics Industry Consortium  
carlos.lee@epic-assoc.com

