

COMPUTER OPTICS AND ITS DEVELOPMENT

Nowadays, many important discipline intercourse and penetrate each other. New subjects are sprung up without end. A new technology revolution is rising over the world. Mankind are facing the severe challenge of information science and technology. New technology revolution in photoelectronic science shows the combination of optics and microelectronic technology, optics and computer science, inputting and outputting, recording and reproducing of picture and image. Computer visual sense and computer color sense. Laser disk technology and photon computer science and technology appearing before mankind not soon are the reflection of the trend of this combination.

Computer optics reflects this trend of combination. Computer optical technology based on computer optics theory and method. Its basic characteristics, on one hand, started on electronic science, microelectronic technology and computer science and gave support to modern optical science and technology providing advanced, high speed and high precision data collecting apparatus, and the method to analyse and to process, and to transform optics and its industrial technology, to enhance its production capacity, to provide advance equipment and technology. On the other hand, started from optical science, photon computer science and technology on the basis of optical devices (chiefly on optical bistable nonlinear optical devices). Photon computer based in optical devices can overcome the intrinsic shortcomings of electronic computer such as the bottle neck, the clock skewing, the bus pushing etc. And can do far more speed parallel operation than electronic computer does. In the following paper, four of the major fields of computer optics will be introduced and discussed.

THE COMBINATION BETWEEN COMPUTER SCIENCE AND OPTICS SCIENCE

At present, there are examples of combination between computer science and optics science everywhere. Television technology is a typical example. In the course of signal transmission (transmitting and receiving) the processing of optical information is realized. (Changing space frequency into time frequency (transmitting) and changing time frequency into space frequency (receiving)).

The wide combination between computer science and optics science is shown with software science and hardware science overlapping and penetrating with branches of modern optics science. If started from computer software and hardware, this overlapping and combination is

classified into computer optical software science and computer optical hardware science and its technology in general. Take the computer optical software as an example, the subjects after combination are computer geometry optics (applied optics), computer physical optics (including optical holography, colority science) computer vision, optical system CAD and processing and management, computer simulation of the interaction between light and substances and photon computer operation software etc. In short, this combination displayed in overall and mutual overlapping and penetrating between computer science and branches of optics science, and therefore pregnancies with much more high technology fields.

OPTICAL SOFTWARE SCIENCE

Owing to the specialities of optics science, the research, the development and the utilization of optical software (including system software and applied software) requires people with special knowledge in optics. Therefore the research team should include special personnel on theoretical optics, applied optics, arithmetical maths and software science and engineer and professional technology workers. Take the optical applied software as an example, we have the following classification: (1) Educational software for optical study (optics education CAE); (2) Design software of optical system (optical system CAD); (3) Optical processing assemble software (optical processing CAM); (4) Optical special assemble software (such as optical filter test and design software); (5) Optical industry administration software; (6) Optical electronic technique software ; (7) Optical system measure and test software; (8) Optical holography (calculation holography and measuring holography) software; (9) Intelligent optical instrument software; (10) Optical (fibre) communication software etc. These software, no matter their research or their development and application require all kinds of personnel in special field to do long - time systematic research work.

OPTICAL HARDWARE SCIENCE

Optical hardware science means: (1) Optical microelectronic technology; (2) Optical computer technology. Setting computer vision as an example now people well understand for the nature of primary vision processing and have algorithm software for a special purpose for some basic vision functions (i.e. vision for eyes). But owing to the complication of computer vision, the research of hardware system concerned with these special purpose algorithm software is necessary.

Special purpose a hardware system mentioned above included function ware completing optical signal sensitive, A/D signal transmission and

visual information processing on the same chip. These functional ware real-time input what concerned with space situation information into computer. At present, people are planning to imitate functions of nervous network with VLSC of three-dimensional architecture as visual information real-time processing. It can be expected that people are possible to make computer visual system matching with living visual system in functions and volumes because of the combination between this kind of visual information processing device and intelligent computer.

Optical hardware required in digital and intelligent work in modern optics and its technology chiefly means opto-electronic chips connected with optical information sensitive, detection and collection and its concerned function ware (such as the IC chips used in camera or in optical instrument). The task done by these function ware can not be completed by function ware of current. It is the task of the optical hardware science to research those microelectronic chips and its related work mechanism and the method of design and production.

PHOTON COMPUTER SCIENCE

Photon computer science based on non-linear devices is a noticeable field in the present world, and also a large field of combination between computer science and optics science. The research work includes the research of photon computer based on optical bistable devices.

Photon computer has the following advantages compared with the electronic computer:

1. Switch time of optical bistable can be much faster than electronic computer devices. Signal transmitting in light speed without the effect by RC time constants and the blocking phenomenon and the twisting of clock pulse to signal transmission in electronic computer and therefore speed the calculation speedup to a higher extent.

2. Optical non-linear device, optical bistable device and optical boolean device permit to input many signals at the same time and process in parallel. Because of the difference between photon and electron, they doesn't intercross each other. Photon has the ability to parallel process in its nature, while electromagnetic signals couple each other and usually cause serious "babble" phenomenon. Computer can do only one-dimension-time processing.

3. Photon computer has very wide frequency bandwidth because of the high wave frequency, and may improve information-transmission volume and information-storing volume. It is estimated that information-storing volume of photon computer would be $1E+15$ times as much as electronic computer, this is very useful for artificial intelligence and computer vision.

Photon computer science aimed at photon computer technology is going to do research work of optical devices such as space photon modulator device, parallel bistable array, optical parallel memory device, all kinds of optical parallel calculation device and applied light detective device. At the same time, because the working principle of photon computer is hard to be replaced by systematic results available by electronic computer, we must research an all-new systematic structure. All-new photon computer should include software system and hardware system. During the research of software system and hardware system. What we should firstly decide to do is which kind of algorithm method and algorithm language we should take so that we can make full use of advantages of optical device and determine the hardware architecture that photon computer should use.

Computer optics is a high science and technology discipline. But no matter microelectron science or optics is a very large science field. They intersected and penetrated each other, and their future development is hard to be expected. But that one point may certain is that the development of computer optics would bring about great effect to mankind. The next is the development of computer optics requires attention of the whole society from personal training to scientific research and production.

SUGGESTIONS AND COMMENTS

Today new science and technology are developing forwards very speedily. We must grasp the chance and take action to speed up the combination of microelectronic technology, computer science and modern optical industry. Computer optics reflects a great trend of new technology revolution in photoelectronics information science, which is the combination of optical technology and microelectronic technology, optics science and computer science. We suggest on adopting the following steps to promote and quicken this combination.

1. To develop the fundamental and applied research of computer optics mainly in universities and colleges. This work includes the basic research of modern optics theories and methods, like computer vision, computer CAD, processing and testing of optical system and photon computer etc.

2. To give full play to advantage of microelectron science and computer science, and to combine with applied physics and applied optics, and to train standard optical knowledge talented persons with various levels of computer optical information.

3. A special liaison agency would be organized by Optical Association (society) in order to promote the lateral connection of optical software and optical hardware. To develop applied research chiefly in institutes and factories, and to make the research results of optical software and optical hardware changed into productive power as quickly as possible.

4. In Optical Association (society), the special committee for computer optics application (optical software and optical hardware branches belong to it), should be set up to improve the work of communication, training and consulting. To develop the lateral connection among optical production line, instrument production line and computer production line.

5. To organize international academic exchange of computer optics and products exhibition to interchange information. To make a quick breakthrough in stress in computer optical application in some fields (optical software, optical (fibre) communication, intelligence optical instrument, etc.).