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Optical Wireless Power Transmission for Fixed Equipment and Mobility

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The power supply wiring for equipment operation is remained. The existence of wiring restricts equipment installation, device functionality, and application and service creations. The use of wireless power transmission in addition to wireless communication is expected to bring about significant changes in society. Although there are various wireless power transmission (WPT) technologies, a novel optical wireless power transmission (OWPT) promise for growing applications by its attractive features [1].

As shown in Fig. 1, the OWPT transmits wirelessly using a light beam. The advantages are expected, such as long-distance power transmission, and simple DC circuits. These also bring advantage of no electromagnetic interference. Although the basic configuration is simple, integration of various functions, from optical systems to control systems is required for a practical system. The concept of OWPT was already introduced in the late 1960s, however, researches on technology and applications have not progressed sufficiently over a long time. By improvement of performances of devices such as efficiency and output power, and improvement of sensing technologies based on IoT, and improvement of control technologies based on improved PC including deep learning technology, OWPT can be expected to be an important technology that accelerates the wireless society.

Figure 2 shows demonstrations of OWPT at Tokyo Tech. By using a high power VCSEL array chip and a commercially available solar cell module, several meters of transmission distance with electric output power of 10W class was demonstrated. The system used a simple lens, and the volume of module was less than 10cm×10cm×10cm. This OWPT can be applied not only to charging IoT terminals and information gadgets, but also to mobility such as drones and vehicles. Currently, only toy class operation has been demonstrated due to limitations in the applicable light output and control systems. Detail will be shown in presentation.

Even in OWPT, transmission efficiency is important as energy technology. Although it is less than 20% by using commercially available devices, it will reach 50% in near future (70% of light source efficiency and 70% of solar cell efficiency). On the other hand, the use of high-power laser beams is limited in terms of safety. By improving device and safety system performance, OWPT will expand wireless applications.

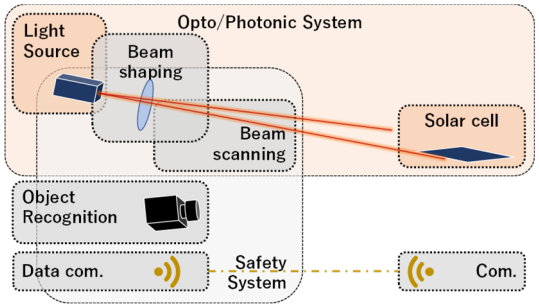
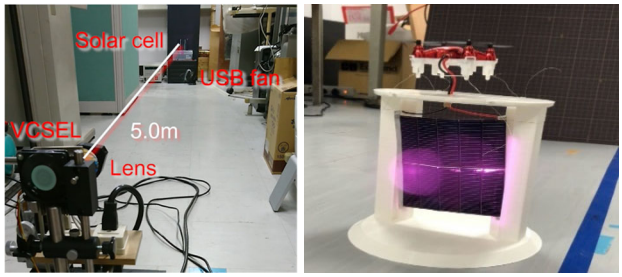


Figure 1. Schematic configuration of OWPT system.



(a) (b)

Figure 2. OWPT demonstration. (a) 5m-long distance OWPT, (b) flying of micro-drone.

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References

[1] T. Miyamoto, "Optical wireless power transmission using VCSELs," *Proc. SPIE*, **10682**, April 2018, 1068204, doi:10.1117/12.2309436.