Photovoltaic Laser Power Converters for Power Beaming

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Abstract:

Photovoltaic Laser Power Converters (PVLPCs) are essential components of Power-by-Light (PBL) systems, which typically consist of a high-power laser source, a transmission medium, and a PVLPC. When the transmission medium is an optical fiber, PBL enables the safe and efficient transfer of electrical power, especially in scenarios where direct electrical connections are impractical or unsafe. Such configurations are commonly referred to as Power-over-Fiber systems. Conversely, when the transmission medium is air or vacuum (free space), PBL facilitates wireless power delivery to remote locations, engines, or equipment in situations where local energy sources are unavailable or insufficient. These systems are often termed Power Beaming Systems [1].

The first PBL system was developed in 1978. However, it is only in recent years that PBL systems have experienced a significant surge, accompanied by continuous efficiency improvements, the emergence of start-ups, and the entry of major corporations into the market. This invited talk provides an overview of the key functionalities of PBL systems, along with a brief historical overview of PVLPCs. A comprehensive comparison of various PVLPC typologies is also presented, examining factors such as efficiency, delivered power, voltage characteristics, temperature effects, and manufacturability. The analysis highlights the respective advantages and disadvantages of each type, tailored to different application scenarios

Currently, PVLPCs stand as the most efficient photovoltaic devices, approaching an impressive efficiency of nearly 70% [2]. In this talk, we examine the primary factors that limit their overall efficiency and explore potential strategies to overcome these challenges. Our goal is to advance PVLPC technology toward delivering power at the kilowatt scale, thereby enabling practical and scalable space applications [3].

Conflicts of Interest

There is no conflict of interest.

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