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Apparatus for Facilitating a Photovoltaic Device to Provide a Wireless Communication Channel

Communications & Information

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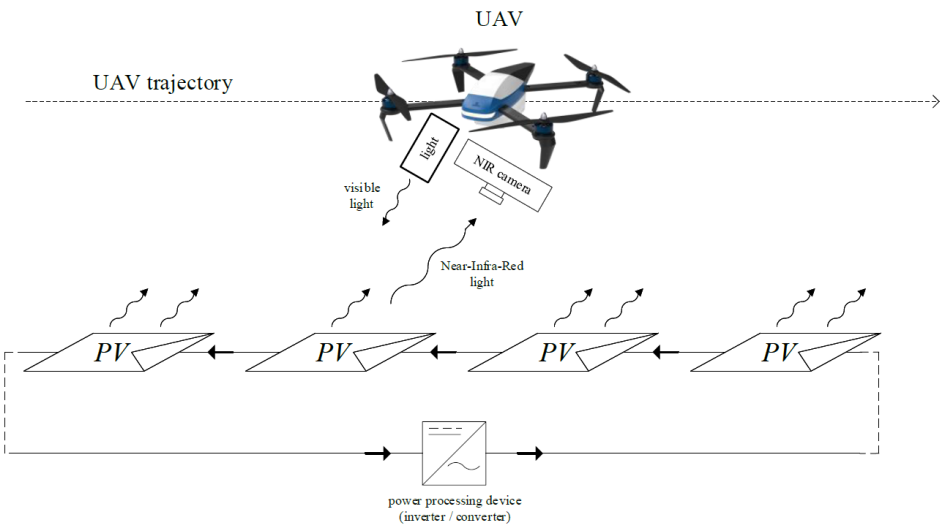

An illustrative example of communication between PV device and UAV. An UAV equipped with artificial light and NIR camera hovering above the forward-biased PV device. The PV device is emitting light in NIR spectrum, because the power processing device feeds the current back to the PV string.

IP Status
Patent granted

Technology Readiness Level (TRL) 5

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Opportunity

Solar power has been branded “the future” of energy production, with photovoltaic (PV) energy generation expected to increase exponentially in the coming decades. PV devices convert sunlight directly into electricity. However, they are considered passive energy generators, because their output depends on the amount of sunlight available. A novel method has been proposed to enhance the functionality of PV devices by turning them into active information transmitters. This will be the first attempt to control the electroluminescent properties of PV devices to optimize wireless communication without changing the devices’ light-to-electricity conversion function.

Technology

PV devices produce an electrical current when illuminated by sunlight. When this current is reversed, feeding electricity back into the PV device, the device emits light in the Near-Infra-Red (NIR) spectrum. This is known as the electroluminescent effect. Reversing the current is a routine step in PV device inspections, with the failure to emit NIR light indicating damage.

Building on this principle, the researchers propose that modulating the electrical current passing through a PV device in turn modulates the device's NIR light emission intensity. With this degree of control, NIR light intensity can be used to transmit information. The proposed technology could replace radio-based devices when local communication (direct, line-of-sight information transmission) is preferable to omnidirectional communication (radio-waves propagating in all directions). The method has been experimentally verified and a prototype device could be developed in 2 months.

Advantages

- Extremely durable communication technology, as PV devices can function for decades.
- Simple PV device hardware: whereas most existing communication technologies require extra hardware (e.g., antennas, radio-signal generators), the proposed device will be simple enough to be integrated into a single component.
- Simple hardware on the receiver/observer side, e.g. NIR cameras that are already used for PV panel monitoring.
- Local communication means that time synchronization between devices is unnecessary (in contrast with traditional wireless and wired communication), thereby reducing costs and avoiding technical obstacles .

Applications

- Direct communication of high-quality information to unmanned aerial vehicles with NIR cameras/sensors, e.g., for automated PV module inspection in solar plants.
- Automated PV device inspection of solar panels, smart-building windows, and electrical vehicles.