Wavevoltaics: a new hybrid wave + photon energy device

Nallapaneni Manoj Kumar

Here, I introduce a new hybrid energy generating device called wavevoltaics. Implications for integrating photovoltaics with wave energy converters and the possibility of designing wavevoltaic devices are discussed.

Many of us have witnessed new trends in renewable energy technologies which could offer their services in meeting the energy requirements at the load centres itself. These technologies have become popular among many nations due to the numerous benefits they could provide. Depending on the renewable resource availability, suitable techniques can be adopted. If a place has abundant solar irradiation potential, then solar photovoltaics or thermal collectors can be used for energy generation[1]. If the place is close to coastal areas, then wave energy converters, and tidal energy systems can be adopted depending upon the wave and tide potential[2]. In recent years, we have witnessed new possibilities in the installation of photovoltaic systems on the roof of building[3], as the integral part of the buildings[4], and on water bodies as floatovoltaics[5] due to land scarcity. Solar photovoltaics have also entered into agriculture, especially in grape fields, as agrivoltaics[6]. In all these installations photovoltaic systems can generate electricity with some added benefits than conventional photovoltaic installations. These added benefits include land-use mitigation, improved energy and material efficiency, etc. Keeping such developments in mind, here we introduce a novel hybrid energy device called wavevoltaics.

Wavevoltaics – wave plus photon energy harvester

Wavevoltaics is an innovative combination of wave energy converter and solar photovoltaics. In this combination, photovoltaics are integrated over the vacant surfaces of the wave energy systems resulting in a hybrid energy-generating device. The proposed device is fully based on the design of wave energy devices. Figure 1 shows two wavevoltaic devices (wavevoltaic attenuator and wavevoltaic rotating mass). These two devices are based on the design of wave energy converter attenuator and rotating mass (wave device by Aqua Ret, 2008)[7,8]. However, the solar photovoltaic cell operation still remains the same even after it is integrated with the wave energy device. The device mostly works on the combined principle of wave energy systems (bobbing principle, hydraulic flapping principle, mechanical flexing, overtopping principle and pressure differential principle) and solar cells (photovoltaic effect).

The possibility of energy generation occurs with the help of both resources; one is from the wave energy source and other from solar potential. The energy outputs of both the systems are converted into useful energy using the electrical energy conversion system. Typically, in most wave energy converters linear electromagnetic generators that generate electricity based on vibration frequencies are used. Similarly, small-scale power converters and regulators can be used for converting energy from photovoltaics. When the wave energy devices are considered on a large scale, there is huge possibility of integrating with solar photovoltaics and making it a novel hybrid energy. On other side, energy efficiency of the proposed device is improved due to favourable factors like reduction in temperatures, and favourable cool winds. Land footprint mitigation also favours the concept of wavevoltaics. There are few drawbacks too, like effect of seawater on the material degradation in the PV cell resulting on the device performance and integration of power converters which would be further analysed.

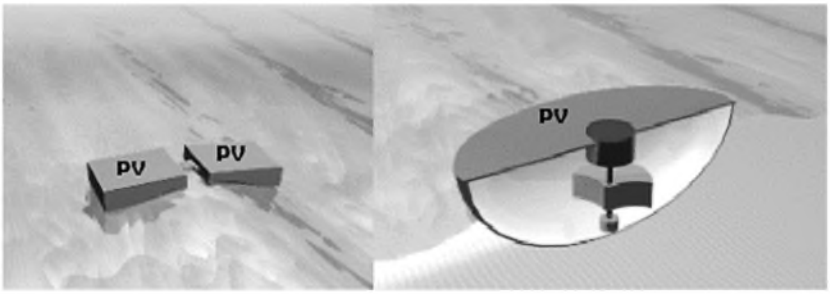

Figure 1. Wavevoltaic attenuator and wavevoltaic rotating mass devices.

1. Manoj Kumar, N., Sudhakar, K. and Samykano, M., *Int. J. Ambient Energy* 2017, 1–10; https://doi.org/10.1080/01430750.2017.1410226
2. Lisboa, R. C., Teixeira, P. R. F. and Fortes, C. J., *Energy*, 2017, **121**, 176–184; https://doi.org/10.1016/j.energy.2017.01.001.
3. Manoj Kumar, N., Navothna, B. and Minz, M., In Proceedings of the 2017 IEEE International Conference on Smart Technology for Smart Nation (SmartTechCon), Reva University, Bangalore, 17–19 August 2017, pp. 709–714.
4. Imenes, A. G., In Proceedings of the 2016 IEEE 43rd Photovoltaic Specialists Conference (PVSC), Portland, OR, USA, 2016, pp. 3147–3152.
5. *Renew. Energy Focus*, 2008 **9**(4), 64–65; https://doi.org/10.1016/S1471-0846(08)-70142-2
6. Amaducci, S., Yin, C. and Colauzzi, M., *Appl. Energy*, 2018, **220**, 545–561; https://doi.org/10.1016/j.apenergy.2018.03.081
7. Wave devices. The European Marine Energy Centre Ltd. http://www.emec.org.uk/marine-energy/wave-devices/ (accessed on 28 August 2018).
8. Aqua-RET Project, European Commission (EU Lifelong Learning Programme Agreement no. LLP/LdV/TOI/2009/IRL – 515), 2008; http://aquaret.com/index.html.

Nallapaneni Manoj Kumar is with the Faculty of Electrical and Electronics Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia. e-mail: nallapanenichow@gmail.com