

Research topic:

**Mechanical systems engineering**

DII research group  
Harvesting- MMSA



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## Rain-drop energy harvesters

Rain-drops impact the ground with a finite velocity, hence they have kinetic energy that usually is lost and in extreme cases can cause damages. In recent years there has been a great development of energy harvesting technologies based on piezoelectric devices and some researches have suggested to exploit the impacts of rain-drops on piezoelectric layers to generate electric energy. Both the possibility of harvesting small amounts of energy for feeding autonomous sensors or small electronic devices and the possibility of harvesting large amounts of energy in tropical countries with large rain rate have been analyzed.

A rain-drop harvester is a multi-physical dynamic system excited by a series of impacts. Experimental results obtained with actual and simulated rain showed that the rain-drops generate series of well-separated force impulses on the harvester, and that the presence of a water layer on the harvester surface may have positive effects on harvester performance.

This research deals with a novel rain-drop harvester equipped with a rectangular container that creates a small pool that is used to collect the rain-drops, see figure 1.



Figure 1. Rain-drop harvester.

This design makes the functioning of the harvester more regular, since the rain-drops impacts always take place on a water layer with a minimum depth.

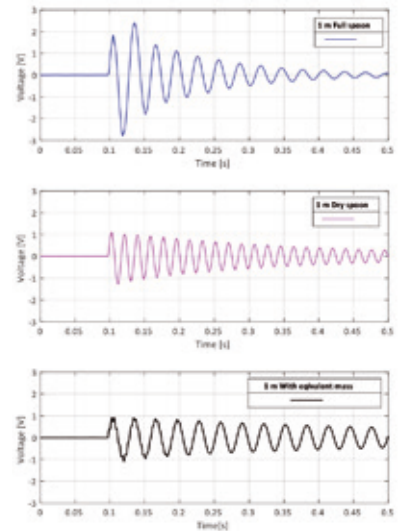


Figure 2. Voltage generated with and without the water layer.

Experimental tests carried out in the laboratory of Mechanical Vibrations of DII with simulated rain show that the presence of the water layer increases the conversion from kinetic energy of the impacting rain drop to electrical energy, see figure 2. Multi-physic dynamic models are developed to explain the increased efficiency of the harvester. Numerical results show that, the added mass of the water in the container reduces the efficiency of the vibrating system, but largely changes the impact dynamics. The second effect is dominant and leads to an increased collection of energy.

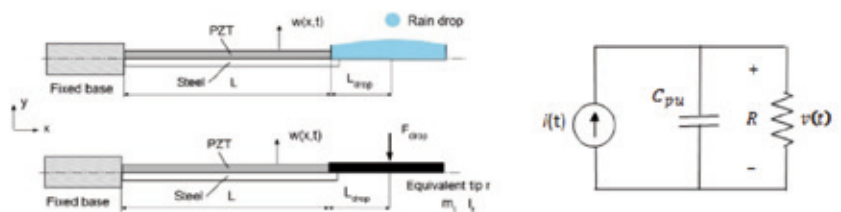


Figure 3. Multi-physical dynamic model.

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Main research topics

- Energy harvesting
- Vibrations generated by impacts
- Multi-physics simulation
- Experimental mechanics