Vibration Based Harvester for Wind Turbines

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Key Words: Wind Turbines, OMA, Autonomous Sensors, Harvesting, Vibrations

ABSTRACT

Non-invasive Structural Health Monitoring requires the deployment of sensors networks to continuously acquire acceleration signals from which modal analysis can be carried out. The need extends to the transportation and building phases of the structures, where damages may also happen. Whatever the case, it is desirable that such sensors be autonomous in terms of both energy and connectivity. To extend the battery life, or even avoid its use, harvesting energy from the environment is a solution.

In the particular case of Wind Turbines (WT), alternatives for powering are scarce, but one source of energy available is the tower vibration itself. Such vibrations are of ultra-low frequency (less than 1 Hz), even lower than those found in other, more investigated, applications such as human movement or sea waves. Displacements, even at the tower tip, are also shorter. Moreover, and unlike those applications, vibrations in any direction on a plane need to be exploited to harvest the most energy.

In this paper we will present designs of vibration harvesters specifically designed for WT. Piezoelectricity, which is the basic principle used in low/medium-frequency vibrations, does not work here. Therefore, our harvesters are based on mechanical to electrical transduction through electromagnetic coupling between moving (rotating) parts comprised of magnets, and coils attached to the structure. The harvesters are modelled, characterized and experimentally tested under similar conditions to those found in an WT under operation. Powers in the range of few mW are obtained, which may suffice to supply low-power sensors.