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Energy Harvesting from Rotating Motion of In-Pipe Robot Cleaning Device

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ABSTRACT

In-pipe robot (IPR) needs a continuous and constant power supply for its operation. This research is a continuation from the previous IPR: D200 for cleaning operation. The objective of this research is to study the possibility of harvesting electrical energy from IPR and how much electrical output can be generated from the proposed solution. The concept is to re-use kinetic energy from high speed rotation of the IPR cleaning device to be converted into electrical energy which can be used to recharge the main battery. Two types of circuits have been developed namely unregulated charging circuit and regulated charging circuit. Both developed circuits are simulated using Livewire software. The developed circuits are then validated using experiment to measure the output voltage. Simulation results show that the unregulated charging circuit can produce output voltage of 10.90V while regulated charging circuit produces an output voltage of 5.47V. Experiments have confirmed that unregulated charging is able to produce higher voltage of 6.93V as compared to regulated charging circuit. The experimental results are lower than simulation results due to power loss during power transmission of the actual circuits. In the meantime, the unregulated charging circuit produced inconsistent output compared to the regulated charging circuit. Therefore, the regulated charging circuit will be considered for the IPR: D200 applications as well as other similar applications.

Keywords: Power regeneration; kinetic energy; electrical energy; in-pipe robot.

INTRODUCTION

Nowadays, application of robots is widely used to assist humans in handling hazardous and difficult tasks. Application of robots in pipeline maintenance and inspection has been established for many years and become more popular due to the nature of inaccessible pipeline and hazardous environment [1]. IPR for cleaning operation of a sewerage pipeline has been developed. A set of nylon cables were rotated by a high speed motor for cleaning operation of the IPR [2].

All movements and control of the IPR is driven by batteries. Battery is a wireless power and an appropriate power source for in-pipe robot in order to improve its mobility. However, power from the battery is not infinite. The battery must be charged regularly to ensure sufficient level of power for operation until it reaches the next manhole (exit). The weight of the battery is the heaviest component compared to the total weight of the IPR [1]. Thus, the battery itself becomes a burden to the IPR as more power is consumed to