

abstract

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FILE	MAIN.PDF (66.15K)		
TIME SUBMITTED	15-MAR-2017 04:17 PM	WORD COUNT	713
SUBMISSION ID	784531958	CHARACTER COUNT	3766

PDEEC - Abstract for Thesis Report Plan

Smart Metering towards energy efficiency increasing in railways systems

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March 15, 2017

Context

To perform energy efficiency analysis and management is required a **1** detailed mapping of energy consumption of a railway system. The load curves of a railway system are divided in its level: at the rolling stock level, at the traction subsection and at auxiliary services. The knowledge of all the load curves permits the load prevision, peak shaving and energy cost optimization for all global railway system.

Work to be done

This work is framed in iRail – innovations in Railway Systems and Technologies – and is aligned with the Shift2Rail objectives – 1. Cutting the life-cycle cost of railway transport by as much as 50%; 2. Doubling the railway capacity; 3. Increasing the reliability and punctuality by as much as 50%. In the framework of the Shift2Rail (S2R) Innovation Programme 3 (IP3) "Cost efficient and reliable infrastructure" it is proposed to develop a Smart Metering Demonstrator (SMD) that **1**ach a detailed monitoring and supervision of various energy flows on the premises of all of the Railway System. The support of all energy management strategy is to build, on top of extensive knowledge **1** of energy flows, the dynamics of every consumers and generators. The SMD is required to validate a standard metering architecture that is coordinating on-board and ground measurements, providing the energy data analysis (in a Big Data type of Operational Data Management (ODM) platform). The purpose **1** this demonstrator is to exploit measured data and the data analysis results, using developed User Applications (UA) and a Railway dedicated Distributed Energy Resource Management System (RDERMS).

Exact work to be done under S2R TD3.

This demonstrator requires the development of non-intrusive Smart Metering sensor networks at Railway System level. Also this technology should be based in an open system and open interface for data collection, aggregation and analysis in an open source Operation Data Management (ODM) platform. In addition, it is expected to design and specify a set of User Applications. Those applications will exploit the energy analysis process with the aim of enhancing the energy decision making and the line operation patterns, as well as other possible improvements such as preventive maintenance.

State of the Art

Based on the state of the art, current metering systems focus on rolling stock on-board energy meters for energy billing purposes, where the metering devices is located close to the pantograph. An advance beyond the state of the art is the measurements at Railway System level, by including both on-board and on trackside. Another advance might be the availability of railway data to the energy market towards the energy efficiency increase by using enhanced prevision capability.

Other point in the state of the art is the measurement at substations. In addition, the energy measured data is usually averaged over a defined period of time which does not permit to perform a correct energy analysis. Currently, the energy analysis is done using data from simulation algorithms based on models that make simplified assumptions on real conditions. To conclude, currently no correlation is made after measurements. An advance to the state of the art is the fine mapping of energy flows for the whole railway system, at continuous and with a refined granularity sampling rate. Another advance is the development of user applications for energy analysis based in real data and not by using simulation data.

A third point in the state of the art is the intrusion level of currently used metering systems, that in one way, became a critical subsystem of the rolling stock and other way, requires relatively long implementation. An advance beyond the state of the art is a solution based on non-intrusive technology and quite sophisticated in one way but mass marketed in other way.

A fourth point in the state of the art, related to the fault tolerance and reliability of wireless sensor networks, is the outlier detection of measured data, affected by external events (such as EMI, temperature, etc) or by internal faults (like overflows, communication jitter, etc). To the knowledge of the author, no work has been done in railway wireless communication systems. Therefore, this topic is relevant to monitoring systems in railways.

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