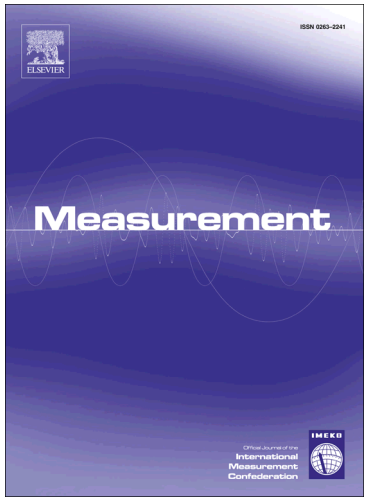

Raspberry Pi as a low-cost data acquisition system for human powered vehicles

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Raspberry Pi as a low-cost data acquisition system for human powered vehicles

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Abstract: The presented work was conducted to test the hypothesis that a Raspberry Pi Model B single board computer can be applied as a riding dynamics data acquisition system for use on human powered vehicles. The research of the subject was followed by the development, which led to a working prototype of such a data acquisition system. The procedure included the system component integration, system software setup and data acquisition software development. The prototype system was tested in laboratory conditions, and in the field using a bicycle as the test vehicle. The results prove the initial hypothesis and confirm that the performance of the developed system is comparable to some higher-priced and less portable data acquisition systems. Other possibilities of application of the developed system and intended future improvements are discussed in the final part of the paper.

Key words: Data acquisition, Riding dynamics, Human powered vehicle, Bicycle, Raspberry Pi

1 Introduction

In vehicle engineering accurate measurements of a wide set of driving dynamics data measured as a time series is often the central part of the research[1, 2]. While specialised measurement systems, tailor-made to suit vehicle measurements[3, 4] are widely available, many of them are expensive and not suitable for use in human-powered vehicles, where on-board power is not available and allowed mass requirements are stricter.

Known as "the most efficient means of transport"[5, 6, 7] the bicycle has its own specifics when it comes to the requirements for an on-board measurement system[8, 9]. Because the bicycle is one of the very few transport vehicles that can carry several times its own weight, the first requirement of any measurement system used on it is that it be as lightweight as possible in order not to alter the bicycle inertial properties and invalidate the measurement results. Before the availability of light embedded computers the low-cost data acquisition systems were usually limited to laptop or netbook computers transported either on the rider's person or on the bicycle itself. Neither of these is ideal, though. The former usually does not significantly alter the mechanical properties of the system and protects the equipment from damage, but complicates the control and cable routing. The latter, on the other hand, may significantly alter the mass distribution of the system (and thus influence the measurement accuracy), and exposes the equipment to vehicle vibrations, causing premature failures. With the development of lightweight embedded computers with sufficient computing power and on-board general purpose