Experimental verification of the uroflowmetry system based on a weight transducer

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Abstract. The aim of this work is the evaluation of metrological properties of the constructed uroflowmeter device. The examination was done on standard flow samples, dosed by a laboratory stand organized for this purpose. The experiment allowed a comparison of flow curves obtained with the use of the constructed device and a standard magnetic-inductive flow sensor SM6000 [1]. The last part of the work contains the analysis of the measurements results, as well as the evaluation of the limiting error of the uroflowmetry device [2, 3].

Keywords: strain gage transducer, uroflowmeter, urine flow, flowmeter.

Introduction

Benign prostatic hyperplasia is one of more frequent diseases of men's urinary system. It is diagnosed when the gland volume is over 30 cm^3 and the maximum urinary flow is less than 15 ml/s. It is estimated that the benign prostatic hyperplasia affects about 50% of men aged around 50 [4]. The high frequency of the disease brings the necessity of working on devices supporting medical diagnostics in this field. The worked out diagnostic unit consists of functional modules, a set of supporting devices and a computer measurement system.

Measurement system

The measurement system was implemented on the base of the platform, in which the first functional module (Fig. 1) is a fluid dispenser. It includes a container and an electromagnetic valve which initiates the flow of the fluid. Because of the comparative character of the research, water was used as the fluid in the measurement system.

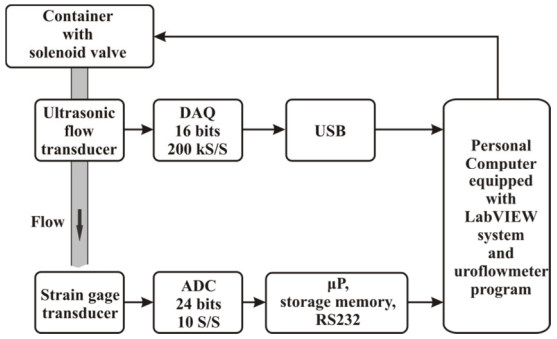

Fig. 1. Measurement system diagram

Another module is the system of the magnetic-inductive flow sensor integrated with a PC by a 16 bit data acquisition card. This part of the system is responsible for measurement data acquisition from the flow meter and its further processing with the use of the LabVIEW program. The SM6000 magnetic-inductive flow sensor takes the role of reference device whose results of the measurements can be compared with the results achieved from the developed instrument. The last element of the laboratory stand is the uroflowmeter itself. It works in the mode which enables independent data storage. The data from the device is read and analyzed in the software made with the use of the C++ language.

Research results

As the result of the research, flow characteristics of a uroflowmeter and an magnetic-inductive flow sensor were determined. In order to present achieved differences for both devices, the most unfavorable case, which occurred during the experiments, was chosen (Fig. 2).

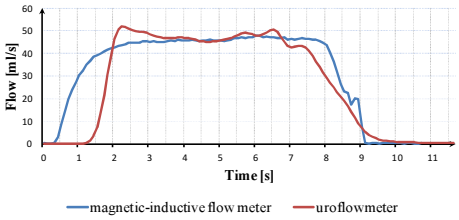

Fig. 2. Uroflowmeter and magnetic-inductive flow meter stored flows

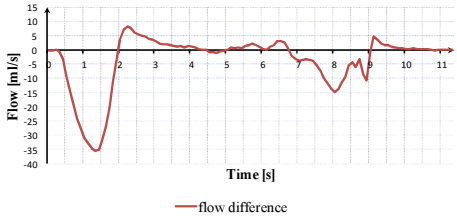

Fig. 3. Achieved flow difference between uroflowmeter and magnetic-inductive flow meter

As it can be observed in Fig. 3, the maximum difference of values appeared in the early phase of flow. This was caused by the fact that the flow meter was placed about 1,5 m away from the weight transducer of the uroflowmeter. In the middle of the section, the maximum difference of the flows equaled about 10 ml/s, and in the final part of the characteristics it was about 18 ml/s.

It can be noticed that the flow measured with the use of the magnetic-inductive device should finish earlier. The main reason of these abnormalities is the lack of synchronization of a sampling time of the analog to digital converter of the uroflowmeter device and the SM6000 sensor. The time difference between achieved samples was nearly 7 ms. It can be accepted as a negligible error while taking into account the duration of micturition, which lasts up to 60 seconds. Yet another factor of the difference can be observed. This is a small amount of the fluid remained in the conducting pipe which is gradually dropped gravitationally with a delay.

Conclusions

The research showed that the constructed uroflowmeter indicates the flow values properly. A small difference between flows, which was observed, can be reduced by proper synchronization of the sampling rate of the analog to digital converter built-in the uroflowmetr device. Despite these minor shortcomings, it was shown that due to the use of the weight transducer, it was possible to work out a construction resistant to temporary flow disappearance which can occur at miction disturbances. Further works will aim at researching the influence of the shape of the forming container (funnel) on the urine flow to the collecting container.

Acknowledgements

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