# THE FUEL CELL DIAGNOSIS SYSTEM CONSTRUCTION, ON THE BASIS OF THE IDENTIFICATION MEASUREMENTS THEORY

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The fuel cell (FC) – this is the efficient, reliable, durable and environmental friendly electrochemical source of the electrical energy. To be improved the FC efficiency and its reliability, it is required the diagnosis systems creation directly in the operation process.

The FC diagnosis system by the electrical noises and its fluctuations, on the basis of the signals identification measurements theory (SIMT) application [2] has been described in this paper.

Thus, the identification measurements theory – this is the intellectual technologies complex (e.g. the methods and the computer tools and facilities) recognition and the digital signals processing. The individual decisions use is positively allowed to be solved some applied challenges, in the field of the diagnosis, the monitoring, and the management.

The form change (e.g. the instantaneous values distribution) and the variability (e.g. the time – interval distribution) signals characteristics, by means of the *identification sale (IS)*, the digitized marks of which are complemented by the quality indicators, for example, in the form of the proper names, having denoted the diagnosis object current state, is the SIMT content.

So, the measuring transformation into the SIMT is interpreted, as the some plurality conversion, for example, the *x(t)* time response, into the IdP number, which is called *the identification parameter*.

In accordance with the SIMT, any realization selected signals can be the identification measurements objects, regardless of their nature (e.g. the periodic, random, composite, and fractal ones), and also their characteristics are the following: the temporary, spectral, correlation, probabilistic ones (e.g. in the form of the histograms).

So, all the enumerated statistical characteristics are practically determined not only for the *x(t)* time response, but also for its derivatives (e.g. increments) $\Delta x(t)$.

So, for the fuel element (FC) diagnosis the $NF_1$ and $NF_2$ are practically measured – the waveforms identification parameters and its increments, respectively, K – is the variability parameter.

The FC diagnosis intellectual system, having operated in two regimes: the training and the measurement, has been proposed, on the basis of the SIMT.

The reference signals, having characterized the various states of the object being diagnosed, are practically formed in the first regime. This may be the signals, corresponding to the experts' opinion, by the FC certain qualitative states. The database (DB), having combined the names of the reference signals (e.g. The File Name), the names of the analyzed characteristics (e.g. the temporary one – Time, the probabilistic one – Hist), the $NF_1$, $NF_2$ and K values, is practically being created for all these signals. The qualitative characteristics, having designated by the experts, are placed in the in the Chart's Column.

It is quite possible to be sorted the DB records, to be set the analysis interval by the filter functions applying, and, thus, to be detected the hidden pattern regularities in its structure. In particular, for the FC state evaluation at the load conditions changing, have already been obtained the following ones:

1) R1 = OC (Chart: idling) under the subject condition provided Time (NF1 = min; NF2 = max; K = min) and Hist (NF2 = min);
2) R1 = 2.4 Ohm (Chart: the optimum resistance) under the subject condition provided Hist (NF1 = max; K = max);
3) R1 = 0.4 Ohm (Chart: the very low resistance) under subject condition provided Hist (K = min);
4) R1 = 4.4 Ohm (Chart: the high resistance) under subject condition provided Time (NF2 = min) and Hist (NF1 = min);
5) R1 = 1 Ohm (Chart: the low resistance) under the subject condition provided and Hist (NF2 = max);
6) R1 = 10.4 Ohm (Chart: the very big resistance) under the subject condition provided Time (NF1 = max; K = max).

The conditions, having filtered the FC qualitative characteristics, are being recorded, in the form of the algorithm, into the memory of the analyzing part of the measurement system. So, the input signal, with the quite unknown qualitative characteristic, is practically analyzed in the measuring mode. For all this, the $NF_1$, $NF_2$ and K values are measured, at which the determined access path to the signal is defined by the recorded algorithm. If the end point of this path is served one of the quality characteristics variants, then this characteristic is practically taken, as the end result of the analysis. The obtained result is always agreed with the experts' opinion of this subject domain, to be avoided the possible errors. If the identification parameters combination of the analyzed signal is not resulted in one of the filtering algorithm's output, then it is practically required, either the DB of the number of the samples to be increased, or the measurement dimension of the identification parameters to be enlarged, by the additional characteristics introducing.

Thus, the proposed expert system can be used to be solved the control, diagnosis, and the management challenges, and also for the other energy facilities and the electronics.

**The References:**

1. *Kadjo J.-J.A., Evdokimov Yu.K., Grigoriev S.A., Fateev V.N., et al.* ,"PEM FUEL CELL Study by Multidisciplinary Approach". // «The Minsk International Colloquium on Physics of Shock Waves, Combustion, Detonation and Non-Equilibrium Processes», MIC 2005, Minsk, 12 – 17 Nov. 2005, p.p. 40 – 41;

2. *Klikushin Yu.N., Koshekov K.T.*,“The Theoretical Bases of the Identification Measurements and Signals Conversion”. // «The Monograph». – Saarbrucken, Germany: LAP LAMBERT Academic Publishing GmbH & Co.KG, 2011. – p. 171.