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RESPONSE TO "COMMENT ON: 'TIME-BASED NOISE REMOVAL FROM MAGNETIC RESONANCE SOUNDING SIGNALS' BY M. SHAHI, H. KHALOOZADEH AND M. K. HAFIZI"

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Abstract. *R. Ghanati and M. Fallah-Safary, in a communication paper in February 2015 issue of International Journal of Innovative Computing, Information and Control, titled "Comment on: 'Time-Based Noise Removal from Magnetic Resonance Sounding Signals' by M. Shahi, H. Khaloozadeh and M. K. Hafizi", comment on our paper from four aspects. We address the comments made by them in this paper and we believe that the response would make the research more fruitful.*

1. At the first stage (the mean criterion), simplifying the mentioned process, E_0 is assumed equal to $S(1)$ which would be the first recorded value of the real signal, and might be less or more than the real or true value.

As mentioned clearly in page 6638, *"to simplify the mentioned process, E_0 is a constant and equal to $S(1)$, the first recorded value of the real signal. The value may not be true and it may be destroyed by the noise, but it may be modified to the real value in the next stage"*, this value is not necessarily true and it must be modified at the next stage. At this stage our goal is not to achieve a correct value for E_0, but at the next stage using the variance criterion, E_0 is estimated and modified to tend to a correct value.

More details would be that, at the first stage, the goal is to survey the area under the curve of the real signal and our computations are on the mean of the noise and the area under the real signal.

For a better understanding, the reader can refer to pages 6638 and 6639 and study the E_0 estimation via the variance criterion.

Another important subject is to mention that based on the principle of energy conservation, the energy of a returned signal from the underground water molecules is finite and bounded, so T_2^* cannot tend to infinity, but apparently the critics mistook it frequently.

2. Generally in the theoretical works, we use the main form of the MRS signal, as the critics stressed in part 2: *"The appropriate and correct time diagram of the signal measurements process is displayed in Figure 2"*. However, contrary to the critics' opinion,

in actual and field works, the MRS equipment acquires data using a synchronous detector to record the data with a lower sampling rate and to simplify the data acquisition. For more explanation the reader should refer to chapter 2, pages 3-9, Ref [1] and (or) part 2.2, from our paper. Since all works in this paper have been done on the real signals, we have depicted the simple and actual form of the MRS signal in Figure 1, page 6637.

It seems the critics are unfamiliar with the concepts of synchronous detection and hardware of the MRS equipment.

3. In reference to page 26, Ref [2], it can be seen that any recording time varies from 240ms to 1040ms, which is related to T_2^* value. In case T_2^* is 1000ms for a signal, the best recording time will be 1040ms based on the table.

Also if T_2^* is 1000ms and we record the data with a recording time equal to 240ms, some useful information will be lost and the data will not be valid.

4. The value of E_0, which is depicted in the figures at initial time, is the first value of the returned signal from the underground water molecules, as the critics stressed in part 4, and it is an ideal value. When we disconnect the high voltage signal (or the transmitted pulse), at first ($t = 0$), some transient regimes will happen. So, if we record the data, errors will occur.

In many measurements, for example, MRS equipment, there is a time delay named "the dead time", in which data recording is stopped (Here the time period is approximately 30ms).

After the signal estimation and considering the estimated relation, we can predict the signal values at the time periods before or after the dead time.

Acknowledgment. The authors would like to thank the respected Editor of IJICIC and the respected critics for their comments. We believe that using the real data of NUMIS and conventional statistical methods is the main contribution of this research. Also other researchers may access better results using other methods.

REFERENCES

[1] S. Strehl, *Development of Strategies for Improved Filtering and Fitting of SNMR-Signals*, MSc Thesis, Technical University of Berlin, 2006.

[2] IRIS Instruments, *NUMIS Surface Proton Magnetic Resonance System for Water Prospecting*, User's Guide, 2002.