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A Novel Artificial Intelligence Based Timing Synchronization Scheme for Smart Grid Applications

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Abstract
The smart grid control applications necessitate real-time communication systems with time efficiency for real-time monitoring, measurement, and control. Time-efficient communication systems should have the ability to function in severe propagation conditions in smart grid applications. The data/packet communications need to be maintained by synchronized timing and reliability through equally considering the signal deterioration occurrences, which are propagation delay, phase errors and channel conditions. Phase synchronization plays a vital part in the digital smart grid to get precise and real-time control measurement information. IEEE C37.118 and IEC 61850 had implemented for the synchronization communication to measure as well as control the smart grid applications. Both IEEE C37.118 and IEC 61850 experienced a huge propagation and packet delays due to synchronization precision issues. Because of these delays and errors, measurement and monitoring of the smart grid application in real-time is not accurate. Therefore, it has been investigated that the time synchronization in real-time is a critical challenge in smart grid applications, and for this issue, other errors raised consequently. The existing communication systems are designed with the phasor measurement unit (PMU) along with communication protocol IEEE C37.118 and uses the GPS timestamps as the reference clock stamps. The absence of GPS increases the clock offsets, which surely can hamper the synchronization process and the full control measurement system that can be imprecise. Therefore, to reduce this clock offsets, a new algorithm is needed which may consider any alternative reference timestamps rather than GPS. The revolutionary Artificial Intelligence (AI) enables the industrial revolution to provide a significant performance to engineering solutions. Therefore, this article proposed the AI-based Synchronization scheme to mitigate smart grid timing issues. The backpropagation neural network is applied as the AI method that employs the timing estimations and error corrections for the precise performances. The novel AIFS scheme is considered the radio communication functionalities in order to connect the external timing server. The performance of the proposed AIFS scheme is evaluated using a MATLAB-based simulation approach. Simulation results show that the proposed scheme performs better than the existing system.

Author Keywords
Backpropagation neural network; GPS; IEEE C37.118; Phase offset; Phasor measurement; Smart grid; Synchronization

Index Keywords
Clocks, Deterioration, Electric power system protection, Electric power transmission networks, Electric substations, Error correction, MATLAB, Neural networks, Radio communication, Real time control, Smart power grids, Synchronization, Timing circuits; Back propagation neural networks, Communication functionality, Industrial revolutions, Real-time communication system, Smart grid applications, Synchronization precision, Synchronization process, Timing synchronization; Phasor measurement units

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