College of Engineering

TENNESSEE TECH

The Department of

Electrical and Computer Engineering

Announces the Thesis Defense

of

Brandon S. England

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

May 20, 2020

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Held in

Tennessee Tech University

Zoom Link: https://tntech.zoom.us/j/2659440778

FIELD OF STUDY

Advanced Metering Infrastructure

DISSERTATION TOPIC

Universal Integrated Infrastructure for Real Time Monitoring and Control of
Smart Grid Areas with Voltage Instability Prediction

EXAMINING COMMITTEE

Dr. Ali Alouani, Committee Chair
Professor, Electrical & Computer Engineering

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ABSTRACT

The smart grid is a classical power grid with added smart meters and communication platform. The added infrastructure is expected to lead to grid efficiency and stability. Existing smart meters are expensive, non-portable, and typically provide only aggregate load measurements with no built-in control infrastructure. The Advanced metering infrastructure (AMI) requires a large bandwidth due to the large amount of data collected by smart meters in real time. The expansion of private grid networks for the AMI bandwidth is prohibitively expensive.

The objectives of this research are three-fold. First, the development of a new generation of affordable multiple load smart meters that use existing consumer communication infrastructure. Individual load monitoring allows for separate load control strategies to increase energy savings. Second, the development of a new generation of advanced metering infrastructure with integrated control capability using the internet as the communication backbone. The use of the internet, already available to most consumers, offloads the existing AMI communication network and makes real time monitoring and control possible. The third is the use of the newly developed multi-load smart meters data to develop an accurate Thévenin parameters estimator, which is used to predict grid areas instability ahead of time to allow utilities to take proper load control actions to prevent blackouts.

The first two contributions of this research, multi-load smart meter and internet-based AMI, were awarded a United States Patent.

Both hardware and software of the proposed infrastructure were successfully developed and tested using experimental and simulation data.

Using a 30 bus IEEE bus system, it was found that the proposed Thévenin estimator, using the proposed multi-load smart meter, predicts instability 40 minutes sooner than when aggregate load measurements are used.

The proposed integrated infrastructure can be used by any utility without dealing with the proprietary protocols used by different smart meters manufacturers.

BIOGRAPHICAL SKETCH

Brandon S. England was born in Crossville, Tennessee, on July 13 1990. He graduated High School with honors in May 2008. He then entered Roane State Community College in 2008. He later transferred to Tennessee Technological University, where He received the degree of Bachelor of Science in Electrical and Computer Engineering in 2014. He continued at Tennessee Technological University and is receiving a PhD degree in Electrical and Computer Engineering.

EDUCATION

Ph.D. Engineering
Tennessee Tech University, August 2020 (expected)

B.S. Electrical Engineering
Tennessee Tech University, May 2014

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