Analysis of Asynchronous Communications on Microgrid State Estimation

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Average consensus algorithms in microgrids are becoming attractive concepts to meet the increasing demands for energy. The goal of the average consensus is to calculate the average of initial values across dispersed nodes by sharing data via communications. The Average Consensus Theorem relies on the local information of agents to guarantee that important information is shared in a distributed way. It is known that synchronization is necessary to obtain an accurate average across the distributed nodes. Due to several technical issues, however, such as the requirement of a global clock and random packet drops/delays, which may occur during the implementation stage, the synchronous model is highly limited in reality. An asynchronous model, a synchronous one's counterpart, naturally takes into consideration the problems mentioned above and is thus more practical. The only downside of the asynchronous model is that it may result in inaccuracies in the consensus value which requires more through investigations. To this end, the performance of different network topologies has been investigated in this study for asynchronous systems with 16 different agents and random initial values. We analyzed three important performance factors: the convergence speed, error bound width with respect to the exact value, and the error variance.

Learning to Run a Power Grid with High Penetration of Renewables

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Renewables are transforming power systems, posing grand challenges to system operations. Increasing data with critical operational insights on the other hand, offers new opportunities in addressing these challenges. However, there is no effective approaches which can collect and synthesize massive measurements from tens of thousands of smart sensors over wide areas to make timely decisions on how to best allocate energy resources. This talk presents a data-driven and learning-based framework for autonomous power systems, and a corresponding software platform named Grid Mind. As recently Grid Mind has been deployed at six grid dispatch centers, results from the real world will be discussed.

Use of Waste Bioproducts as a CO2 Sink in Sustainable Structural Composites

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By identifying useful waste streams, bio-manufacturing technologies such as sustainable composite materials can be developed to offset CO2 emissions. Waste biomass offers many material advantages such as biosequestration, biomineralization, and improved mechanical properties. By incorporated bio-waste into cementitious, pressed, and hydrogel materials we aim to develop bio-composites for applications in structural materials, 3D printing, and fuel pellets. Samples were prepared and characterized using a wide range of chemical, mechanical, and spectroscopic techniques. From this study, we evaluated the effects of waste biomass in sustainable composites for CO2 mitigation, reduced construction cost, and waste utilization potential.

IoT Enabled Healthcare Monitoring System

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To address the drawbacks of conventional healthcare and satisfy the increasing demand for high-quality care, a large amount of research is presently focused on smart healthcare. This work presents an Internet of Things (IoT) enabled healthcare monitoring system for building smart healthcare. This work consists of three parts: a sensor unit, a detection unit, and an IoT unit. The sensor unit continuously monitors and records patients' health activity using sensors. The detection unit uses a machine learning algorithm to analyze signals and detects abnormal patterns. IoT unit enables physicians or authorized personnel to keep track of a patient's health status through the internet. The system displays real-time information on a person's status via IoT. The sensor unit and detection unit have been implemented using Arduino, ESP 8266 (wi-fi module). An open data platform, ThinkSpeak, has been utilized for IoT. The proposed approach reports a high detection accuracy and low power consumption, which can be beneficial for smart healthcare systems.