

Understanding GPS and Synchrophasor Technology in Power Systems

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Summary

The recording is a detailed lecture on the workings of GPS technology and its application in synchrophasor measurements for power systems. The speaker explains the concept of pseudo range and how GPS receivers calculate true distances using satellite signals. The lecture covers the importance of accurate time synchronization in power systems using GPS signals, which provide one pulse per second to synchronize phasor measurement units (PMUs). The discussion includes the IEEE C37.118 standard, which specifies the requirements for synchrophasor measurements and communication. The speaker highlights the difference between protection and measurement classes of PMUs, emphasizing the need for accuracy in synchrophasor measurements. Various applications of synchrophasors, such as state estimation, out-of-step relaying, and small signal oscillation detection, are discussed. The lecture also addresses challenges like synchrophasor quality issues and the lack of cybersecurity measures in the current standards. The session concludes with administrative details about assignments and evaluations.

Action Points

- Submit self-evaluation for all three assignments by next Wednesday.
- Complete assignment number three by Monday.
- Prepare for a potential quiz on synchrophasor topics.
- Review the final exam format on the last day of class, June 16th.

Key Topics

Introduction to GPS and Pseudo Range

The speaker introduces the concept of pseudo range in GPS technology, explaining how receivers calculate distances using satellite signals. The importance of accurate time synchronization in determining true distances is emphasized, with a focus on the role of ΔT and the speed of light in these calculations.

GPS Signal Processing and Satellite Positioning

The lecture delves into how GPS receivers process signals from satellites, including the calculation of pseudo range and clock error. The speaker explains how satellites provide their position and orbital parameters, allowing receivers to determine satellite positions at any given time.

Synchrophasor Technology and PMU Functionality

The speaker discusses the role of phasor measurement units (PMUs) in power systems, highlighting how they use GPS signals for time synchronization. The process of dividing one pulse per second into sampling rates for accurate phasor measurements is explained, along with the importance of maintaining synchronization across PMUs.

IEEE C37.118 Standard for Synchrophasors

The lecture covers the IEEE C37.118 standard, which outlines the requirements for synchrophasor measurements and communication. The speaker explains the time tagging of synchrophasors, accuracy requirements, and the distinction between protection and measurement classes of PMUs.

Applications and Challenges of Synchrophasors

Various applications of synchrophasors in power systems are discussed, including state estimation, out-of-step relaying, and small signal oscillation detection. The speaker addresses challenges such as synchrophasor quality issues and the need for updated standards to address cybersecurity concerns.

Administrative Details and Assignments

The session concludes with administrative details regarding assignments and evaluations. The speaker reminds students to submit self-evaluations and complete assignments by specified deadlines. The possibility of a quiz on synchrophasor topics is mentioned, along with details about the final exam format.