A Generalized PSS Architecture for Balancing Transient and Small-Signal Response

This technology offers a power system stabilizer architecture to improve the control and interactions in bulk system dynamics. It utilizes a real-time estimates of the center-of-inertia speed and create a flexible set of trade-offs between transient and small-signal response.

What is the Problem?

The delicate balance between synchronizing and damping torque components in a synchronous machine creates a conflicting set of stability-oriented exciter performance requirements. Power system stabilizers (PSS) have long played a critical role in satisfying these requirements; however, changes in bulk system dynamics pose challenges to existing control strategies. As inverter-coupled variable generation displaces synchronous machines, electric grids lose inertia and traditional sources of voltage support and oscillation damping. Correspondingly, the rapid growth of power electronic loads has the potential to make the system load stiffer with respect to changes in voltage. In parallel with these changes, wide-area measurement systems (WAMS) have transformed power system monitoring. The deployment of phasor measurement units (PMUs) has made it possible to implement control strategies that act on information transmitted over long geographic distances in nearly real time.

What is the Solution?

The solution is a new PSS architecture that can be viewed as a generalization of the standard Delta-omega (speed deviation) stabilizer. This control strategy stems from a time-varying linearization of the equations of motion for a synchronous machine. It utilizes a real-time estimate of the center-of-inertia speed derived from a set of wide-area measurements. Using this technique, it is possible to almost wash out steady-state changes completely in rotor speed from the control error. Consequently, it creates a flexible set of trade-offs between transient and small-signal response. Basing the control error not only on local information but also on changes in the system operating point can improve frequency response and rotor angle stability, particularly in stressed systems.

What Differentiates it from Solutions Available Today?

Existing power system stabilizers have challenges when dealing with changes in bulk system dynamics. In comparison to traditional approaches, this strategy offers improved control over interactions between the PSS and automatic voltage regulator (AVR).

Technology ID

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Category

Cleantech/Energy Efficiency
Selection of Available Technologies

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References

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