



## Variable Loop Gain for a Wide-Area Control System

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**Patent Status:**

Utility Patent

### Description of Technology

Wide-area damping controllers (WADCs) stabilize large, interconnected grids with separate generating and load centers. The grids exhibit significant resonant characteristics and high renewable generation penetration. Time delay in such systems is a major threat to the performance of these carefully designed controller systems. The time delay threats can appear in several forms, including network congestion due to unusually high traffic, sampling using analog-to-digital converters, or even malicious attacks by cyber hackers intentionally introducing time delay into a system. If too much time delay occurs, even the most conservatively designed systems can become unstable. Many researchers are trying to find solutions to this problem; however, their solutions assume that a closed loop system response in itself is sufficient enough to illustrate the impact of excessive time delay.

Researchers at the University of Wyoming developed a system that is insensitive to the assumptions made by other approaches. Therefore, their approach is not a function of assumptions related to delay, including the ability to measure delay, assumed delay patterns, or a constantly delayed system. UW researchers' approach allows GPS spoofing attacks to be caught and action taken against them before any damage is done to the system. Additionally, minimum phase compensation is not utilized to combat the nonminimum phase contributed by delay directly, which allows a strict bandwidth to be enforced.

### Applications

This technology has applications in the aerospace industry due to the nonminimum phase-changing regeneration. The approach could also be used in the process control industry, precision pointing/additive manufacturing, and for local power system control.

### Features & Benefits

- Insensitive to assumptions made by other systems
- Ability to measure delay patterns
- Ability to notice a constantly delayed system
- Can pick up on GPS spoofing attacks and take counter measures before any damage is done

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