Researchers at the University of South Florida have discovered various ways to control feedback of power systems to provide simultaneous frequency regulation and economic operation.

State-of-the-art distributed power system optimization applications have focused on power system models that are represented by algebraic equations, where the power balance is an equality constraint that is monitored. For example, droop control is a primal-dual iterative optimization procedure that is not scalable if the information from neighboring generators are utilized. These control systems take time to converge, and cannot be fine tuned to the specific system they are controlling. There is a need for describing connections between elements of power systems and the dispatch controller using a simpler, straightforward model that can be solved faster and results in more economic operation.

USF inventors have developed a controller that linearly relates frequency deviation to power imbalance. This greatly facilitates the implementation of distributed decision making using tunable platforms reflecting frequency dynamics. This invention also provides methods to optimize the parameters of the provided tiered local and global integral control algorithms such that the system is tuned to achieve economic operation and frequency regulation simultaneously. Each generator’s parameters are independently optimized, enhancing efficiency of heterogeneous systems. The invention allows reducing the frequency of centralized economic dispatch since the provided automatic gain controller (AGC) takes care of economic operation. This invention can be applied to economic dispatch, AC optimal power flow (AC-OPF), DC optimal power flow, voltage control, multi-horizon optimization such as electric vehicle operation and battery operation.

**ADVANTAGES:**

- Scalable multi-tier algorithm optimized for heterogeneous power systems
- Faster response than state-of-the-art
- Supports mixture of continuous and discrete controllers

**Simultaneous Frequency Regulation and Economic Power System Operation**

**Two-Area Four-Machine Power System Utilizing the Invention Platform**

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