System Frequency as Information Carrier in AC Power Systems

Power generators contain control systems able to regulate system frequency, but the frequency setpoint values are only rarely modified from nominal values. This paper describes design considerations for a communication system from generators to frequency sensitive distributed energy resources (FS-DER) using changes to frequency setpoint values of generators. Signaling discrete system states by generating off-nominal system frequency values can be used as a novel narrowband unidirectional broadcast communications channel. This paper describes two protocols for utilizing off-nominal frequencies to carry information: First, a protocol for dispatching blocks of FS-DER that is suitable for systems restricted to relatively slow rates of change of frequency (ROCOF). Second, for systems that allow higher ROCOF values, the feasibility of using power generation resources as a power line communication transmitter is shown. Data from an operating islanded power system with diesel generators is analyzed to demonstrate the feasibility of the proposed communication system in systems fed by rotating machines. The feasibility of the proposed communication system in systems fed by voltage source inverters is shown with laboratory tests of a 20 kVA inverter. The inverter was found to have a maximum ROCOF of 2.2 Hz/s, sufficient to enable its use as a power line communication transmitter.
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