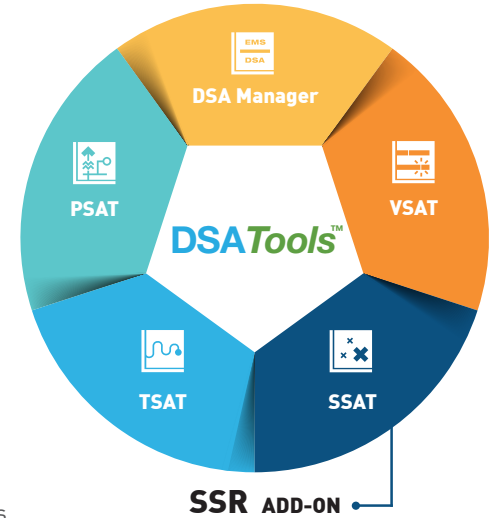


SSR Sub-Synchronous Resonance Analysis

The Sub-Synchronous Resonance (SSR) analysis module is an add-on module to SSAT that provides an easy-to-use interface to systematically perform SSR analysis of a power system in frequency domain.



By combining frequency scan and modal analysis, SSR offers the capabilities of identifying critical SSR modes and the machines interacting with these modes.

The frequency scan analysis is used to identify network resonant modes observable at the terminal buses of different generators. The results can help narrow down the region of studies so that detailed modal analysis can be performed only for the generators that are more likely to interact with these modes.

Graphics are utilized to visualize network resonant modes, torsional modes, and the possible SSR interactions with different levels of compensation for transmission lines.

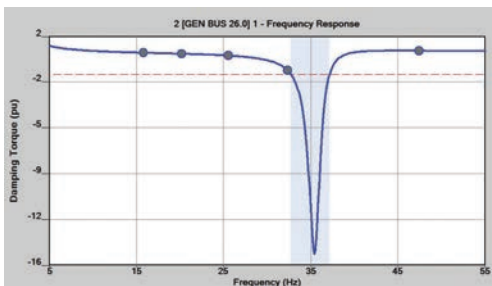
APPROACH

The SSR uses the following methods:

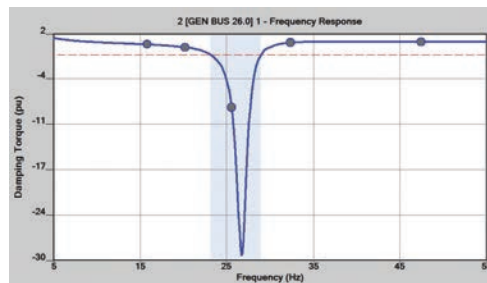
- Frequency scan technique is applied for:
 - Identifying network resonance frequencies.
 - Evaluating network damping torque for synchronous generators.
 - Evaluating network and wind-turbine generators' harmonic impedance.
- Local mode analysis is used for:
 - Computing torsional modes of synchronous generators.
 - Investigating possibility of torsional interactions between synchronous generators and network.
- System mode analysis performs an eigenvalue analysis for SSR modes considering all system dynamics

SAMPLE RESULTS

The following figures show the frequency scan results for the IEEE first benchmark model for SSR analysis:



30% Compensation (Safe)

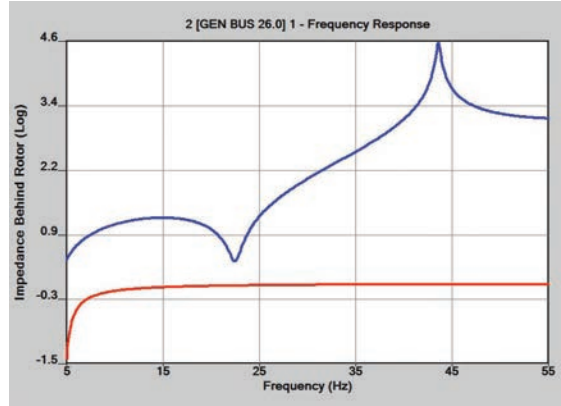
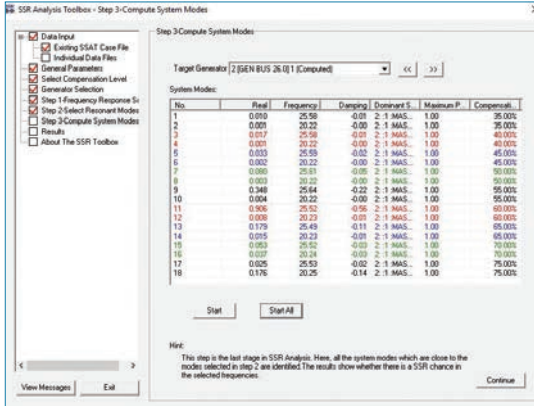


55% Compensation (SSR interaction at 25Hz)

PRODUCT FEATURES:

- Based on frequency scan technique and modal analysis method
- Identify network resonance frequencies
- Identify generators interacting with network dynamics
- Identify interactions between network dynamics and control systems of wind-turbine generators
- Determine possible SSR frequencies and damping
- Analyze systems with different levels of compensation for transmission lines

SSR Sub-Synchronous Resonance Analysis



Modal analysis performed for two torsional modes with different levels of compensation. The results show that there exists a significant chance of SSR interaction at 55%, 60%, and 75% compensation levels.

Evaluating harmonic impedance for a wind-turbine generator. In this case, there is a chance of SSCI since total harmonic resistance (network + wind-turbine generator) is negative at SSR frequency.

APPLICATIONS

The SSR module is designed as a screening tool to identify possible SSR risks in a power system, which includes torsional interactions (TI) in synchronous machines and sub-synchronous control interactions (SSCI) in wind-turbine generators. If such risks do exist, the SSR

module can help pinpoint the locations and the associated frequencies/damping of the SSR. This would help perform studies using detailed time-domain simulations to verify the SSR risks. The SSR module can also be used to investigate mitigation measures for the confirmed SSR.

SPECIFICATIONS AND REQUIREMENTS

- Runs on MS Windows 7/10/server 2012 R2/server 2016
- Requires SSAT to run

OTHER POWERTECH SERVICES

- Licensing of the power system analysis software package DSATools™
- Licensing of other software products for utility applications
- Implementation of on-line dynamic security assessment (DSA) systems
- Development of custom software systems
- Development of models for use in power system analysis
- Generator field testing, model development and validation
- Training
- Technical consultancy studies including
 - Development of power system base cases
 - System planning and operation studies
 - Facility (including renewables) interconnection studies
 - Compliancy studies (such as NERC TPL, CIP, UFLS, etc.)
 - Post-mortem analysis of system disturbances

ABOUT POWERTECH LABS

PowerTech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Outside of the utilities industry, PowerTech provides routine testing capabilities, product development, research and consulting services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.

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