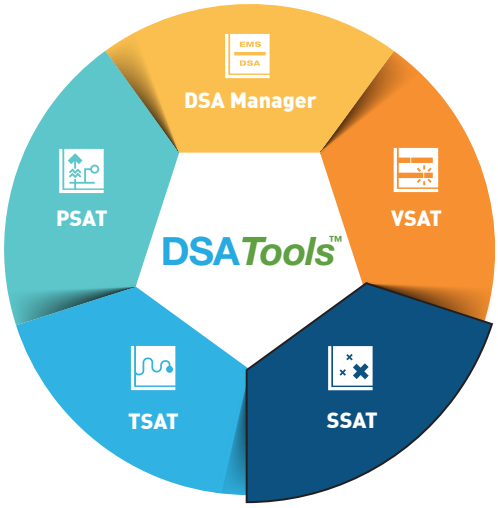
SSAT Small Signal Analysis Tool

SSAT is a software tool for small signal stability analysis of power systems. This tool is designed to help investigate, and provide solutions to, the system oscillation problems that have been increasingly recognized as important security concerns for the operation of systems.



SSAT's extensive computational capabilities offer a "one-stop" solution to the small signal stability problem.

Complemented by other tools in the DSA*Tools*™ suite, namely PSAT (Powerflow & Short circuit Analysis Tool), VSAT (Voltage Security Assessment Tool), TSAT (Transient Security Assessment Tool), and its own add-on modules CDT (Control Design Toolbox) and SSR (SubSynchronous Resonance analysis), SSAT provides accurate small signal stability assessment of power systems.

SSAT is built on the linearized dynamic model of a power system and it uses modal (eigenvalue) analysis techniques to assess the small signal behavior of the system. A number of eigenvalue computation algorithms are implemented in SSAT to cater to different types of applications, including:

- QR algorithm
- Implicitly restarting Arnoldi algorithm
- Enhanced version of AESOPS algorithm

Each algorithm is used to solve specific modal analysis problems.

The eigenvalue computation algorithms are applied to the power system model that has been formulated in such a way to ensure accuracy of results and efficiency of computations:

- Analytical linearization is used to derive the linear dynamic model of the system.
- Matrix transformations are performed to focus computations on required mode types.

The advanced computation features and analysis options in SSAT are embedded in an easy–to-use interface which allows the user to create study cases and to specify computation tasks effortlessly. Assisting tools such as UDMEditor, CDT, SSR, and Case Scheduler further simplify use.

The modeling and data requirements for SSAT are compatible with those for nonlinear time-domain simulations (such as TSAT).

SSAT can be used in a broad range of applications, including validation and calibration of dynamic models, verification of system oscillations, identification of characteristics for critical modes, system planning and operation studies, determination of stability limits, and control system design and tuning.

SSAT incorporates many innovative features and advanced functionalities for small signal stability analysis.

PRODUCT FEATURES:

- *Extensive and flexible modeling capability*
- *Six eigenvalue calculation options to address different modal analysis problems*
- *Small signal stability index computation*
- *Frequency/step response computation*
- *Comprehensive system analysis tools*
- *Case setup and analysis tools*
- *Support of major power system data formats*
- *Available add-on modules for specific analysis tasks*

Powertech

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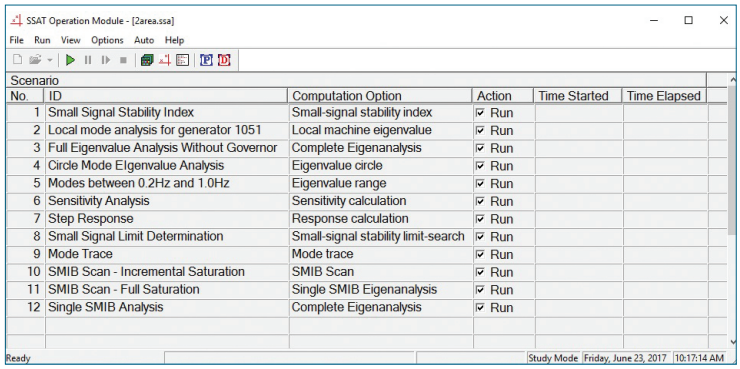


No.	ID	Computation Option	Action	Time Started	Time Elapsed
1	Small Signal Stability Index	Small-signal stability index	Run		
2	Local mode analysis for generator 1051	Local machine eigenvalue	Run		
3	Full Eigenvalue Analysis Without Governor	Complete Eigenanalysis	Run		
4	Circle Mode EIgenvalue Analysis	Eigenvalue circle	Run		
5	Modes between 0.2Hz and 1.0Hz	Eigenvalue range	Run		
6	Sensitivity Analysis	Sensitivity calculation	Run		
7	Step Response	Response calculation	Run		
8	Small Signal Limit Determination	Small-signal stability limit-search	Run		
9	Mode Trace	Mode trace	Run		
10	SMIB Scan - Incremental Saturation	SMIB Scan	Run		
11	SMIB Scan - Full Saturation	Single SMIB Eigenanalysis	Run		
12	Single SMIB Analysis	Complete Eigenanalysis	Run		

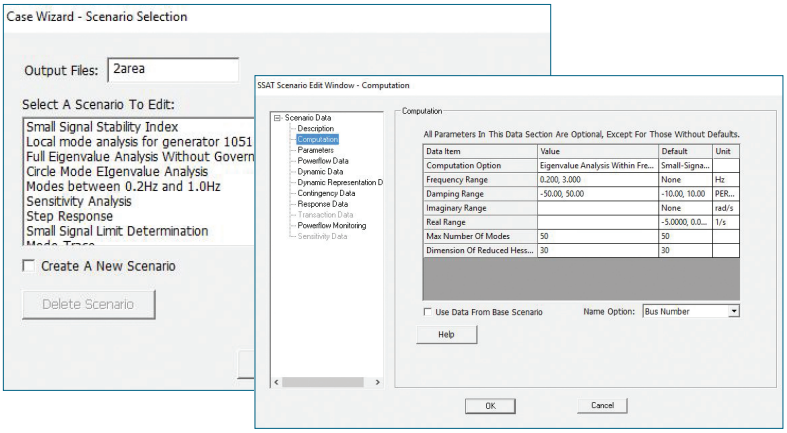
MODEL LIBRARY

SSAT supports a comprehensive model library, including the following conventional models:

- **Generator:** from classical to two-axis 6th order models.
- **Excitation system:** all IEEE standard exciter/AVR and PSS models and common extended models.
- **Speed governing system:** all IEEE standard models and common extended models.
- **Load:** ZIP model, voltage/frequency dependent model, induction motor model.

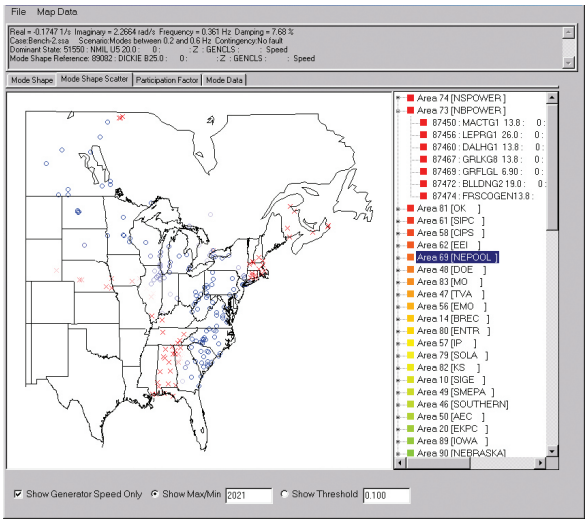
Among the advanced modeling capabilities, SSAT supports:

- **Renewable energy source models:** wind turbines, photovoltaic plants, storage devices, etc.
- **User-defined modeling:** function block and connectivity-based UDM approach with capability to interface with user-written control blocks.
- **FACTS model library:** SVC, TCBR, STATCOM, TCSC, SSSC, TCMCT, TCPST.
- **HVDC model library:** two- and multi-terminal HVDC models (LCCand VSC), converter-based FACTS models.



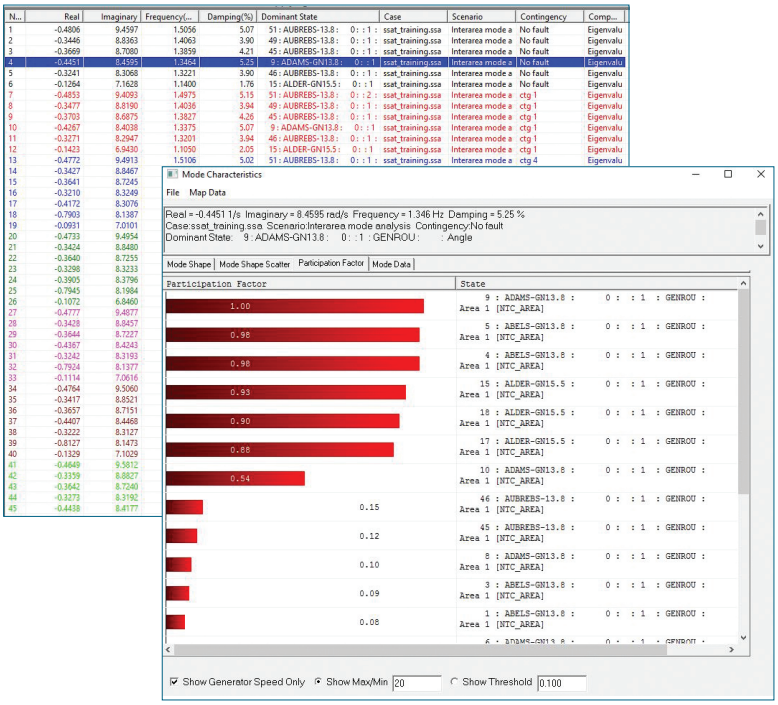
ANALYSIS OPTIONS

- **Contingency analysis:** in addition to the base case, post-contingency conditions can be studied.
- **Sensitivity analysis:** the sensitivities of specific modes with respect to dynamic model parameters and various system conditions can be assessed.
- **Transfer analysis:** this determines the power transfer limits subject to small signal stability criterion, for power transfers defined using the same concept as VSAT and TSAT.
- **Mode trace (root locus) analysis:** specific modes can be traced for specified power transfers (or powerflow conditions), contingencies, and/or dynamic model parameters.



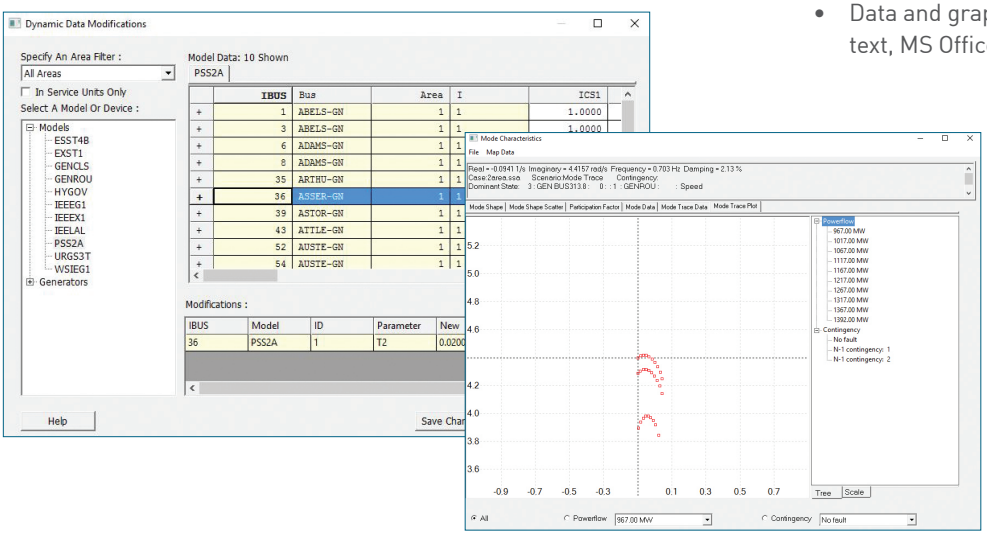
COMPUTATION FEATURES

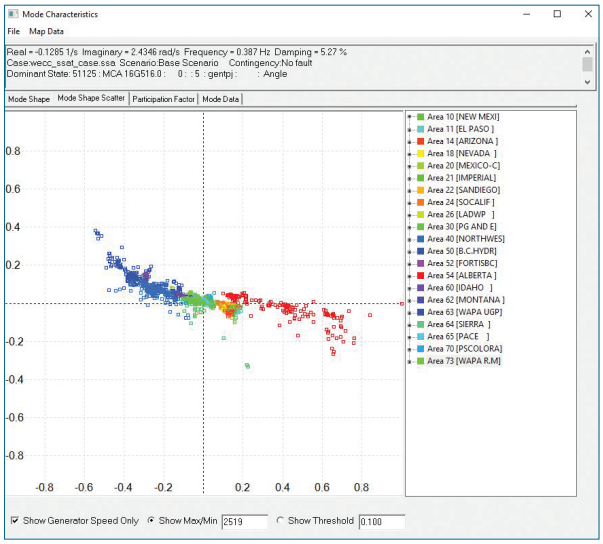
- Computation of all modes in a system or in single-machine-infinite-bus equivalents for all generators.
- Computation of the modes within a specified range of frequencies and/or damping (ideal for computation of interarea modes).
- Computation of the modes associated with specified generators (ideal for computation of local modes).
- Computation of small signal stability indices, including the entire spectrum or specific modes defined by frequency ranges or participating generators.
- Full modal characteristics (mode shapes and participation factors) for the modes computed.
- Time and frequency response computation (useful for control design/tuning and model validation).



CASE SETUP TOOL

- The Case Wizard helps create study cases and computation tasks.
- Full graphic interface for working with all data required.
- Creation of contingencies with custom events or by rules.
- Connection to UDMEditor for creating, examining, and modifying user-defined models.
- Connection to PSAT for examining, modifying, and solving powerflow.





OUTPUT ANALYSIS TOOL

The Output Analysis Module of SSAT helps examine all computation results from SSAT runs:

- Different views (tabular or graphical) for the visualization of results.
- Various analysis tools to show trends and patterns from the raw computation results.
- Tools for identification of local/interarea modes, and for filtering specific modes from multiple computation scenarios and contingencies.
- Geographical display of modal characteristics, with full "on-the-fly" editing functionality.
- Case comparisons.
- Fully customizable plots.
- Data and graphics importing/exporting facilities (ASCII text, MS Office, and HTML).

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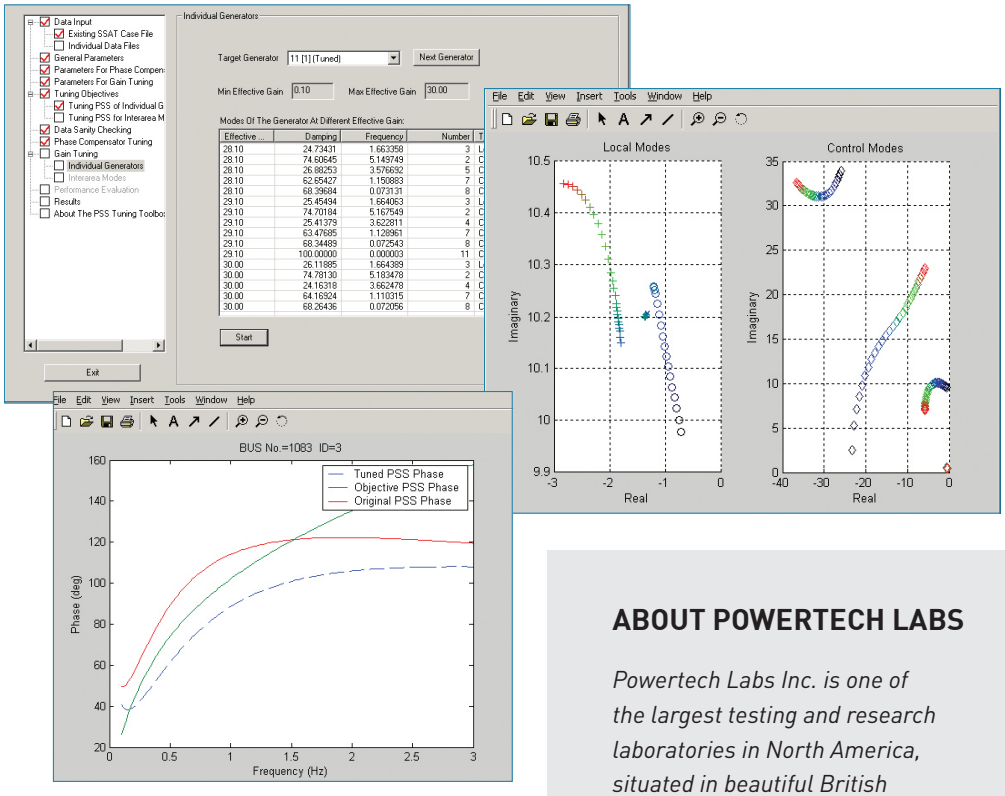
OTHER FEATURES

- Capability to integrate, through the DSA Manager™ module, with EMS for online dynamic security assessment.
- Power system components can be identified using bus numbers, bus names, or equipment names.
- Multiple scenario and multiple contingency processing capability.
- Option to use single or double precision arithmetic, selectable at run-time.
- Option to export basic matrices of the linear dynamic model of the system.
- Case Archive feature to allow easy archiving and exchange of study cases.
- Batch processing
- Support of using script language (such as Python) to extract and export computation results.
- Analysis of power systems of up to 100,000 buses and 15,000 generators.
- Runs on MS Windows 7/10/server 2012 R2/server 2016



OTHER POWERTECH SERVICES

- Licensing of the power system analysis software package DSA*Tools*™
- 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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