



Signal Processing and Noise Analysis Package "BRUS II"

A powerful tool for your evaluation of recorded process signals

Introduction

BRUS, which is a Swedish word meaning noise, is a package code dedicated to signal processing and noise analysis. This package code has been developed in GSE Power Systems AB by accumulating abundant experiences gained through years of signal analysis activities in various projects. Unlike other general commercial codes, BRUS has a unique feature as follows:

- BRUS contains a complete set of tools necessary for the signal analysis starting with data file construction, signal quality evaluation, signal preprocessing and to different kinds of signal analyses.
- In many cases, the result of signal analysis provides the estimate of characteristic parameters of the signal behavior, e.g. time constant, decay ratio, resonance frequency, etc.

These estimates are directly applicable to process monitoring, surveillance, diagnosis, control parameter tuning and so forth.

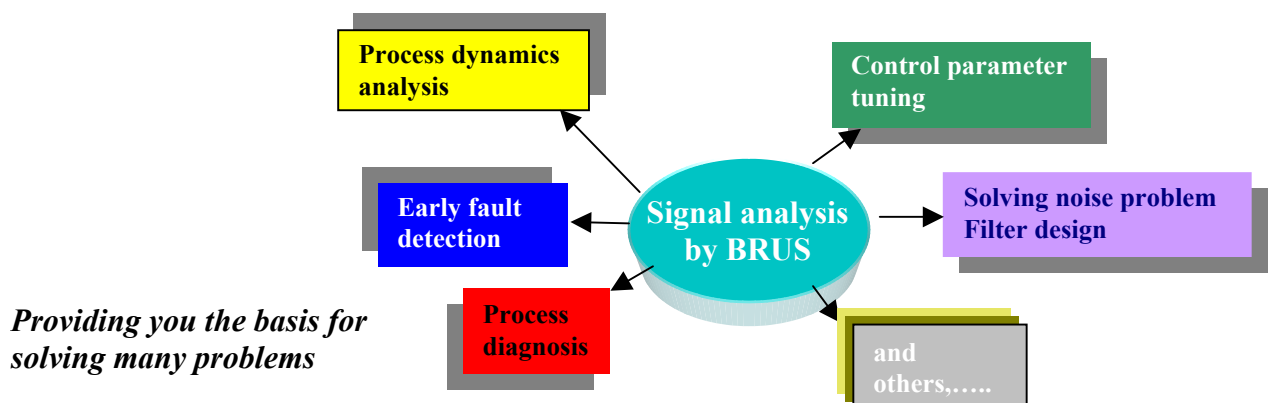
- The Windows-based graphic interface is in many cases self explaining on the analysis procedure, thus allowing various analysis without requiring detailed knowledge or skills in signal analysis.
- BRUS includes a number of built-in tuning parameters, which often play an important role in getting a good result. The parameter values have been well tuned based on our experiences and embedded in the program as defaults so that the user does not need to worry about them.

The BRUS package has been developed in Windows-NT. It works on MATLAB with toolboxes for Signal Processing, System Identification and Control System.

Main functions

The BRUS package contains the following six main functions:

- File conversion: for data file conversion to create the specific file format used in BRUS.
- Raw data evaluation: collection of tools to quickly check signal quality as well as statistical characteristics.
- Signal preprocessing: to enhance the signal quality so that one can get best possible result from the analysis.
- FFT analysis: collection of noise analysis tools based on FFT (Fast Fourier Transform).
- Univariate parametric analysis: collection of time and frequency domain tools based on AR/ARMA model.
- Multivariate parametric analysis: various tools for multivariable signal analysis based on MAR model.



- Raw data evaluation:

Plot time series data, trend evaluation, histogram evaluation, signal stationarity check, signal statistics evaluation, mean value, standard deviation, skewness and kurtosis

- Signal preprocessing:

Trend subtraction, outlier elimination, digital filtering (low & high pass), data reduction (decimation), signal synthesis, etc.

- FFT analysis:

Correlation analysis, spectral analysis, coherence analysis, frequency response analysis, cepstrum analysis (*)

- Univariate parametric model identification AR and ARMA(*) and Analysis

Time domain: step & impulse response analysis

Frequency domain: spectral analysis

Pole evaluation: dynamics characteristic parameters characteristic parameter check

- Multivariate parametric model (BAR, MAR, ARX) identification and analysis

Time domain: impulse response, step response, output estimation

Frequency domain: spectral analysis, coherence analysis, NPC, partial NPC(*), and STP(*) analyses, frequency response analysis

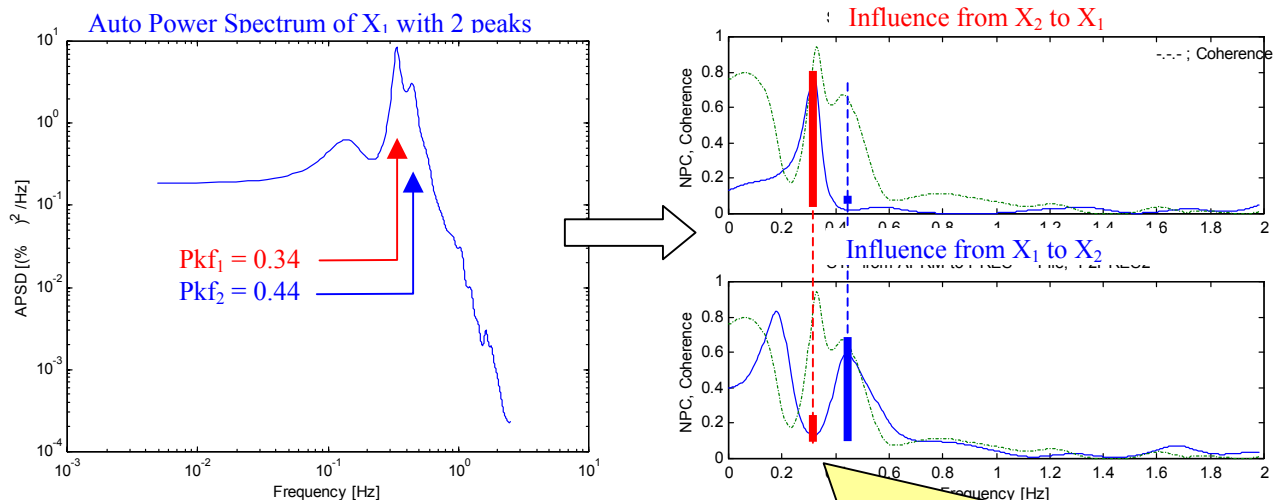
Others: check noise source characteristic

(*) optional.

AR: auto-regressive, ARMA: auto-regressive and moving average, ARX: auto-regressive and eXogenous,

MAR: multivariate AR, NPC: noise power contribution, STP: signal transmission path

**Example: Process diagnosis with the aid of multivariable noise analysis
Estimation of cause of two spectral peaks**



Cause consequence analysis indicating different perturbation sources
 $X_1 \rightarrow X_2$ at 0.44Hz and $X_2 \rightarrow X_1$ at 0.34Hz.

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