

GoSUM: A Complexity Management Software Tool

For engineers, consultants, modelers and data analysts

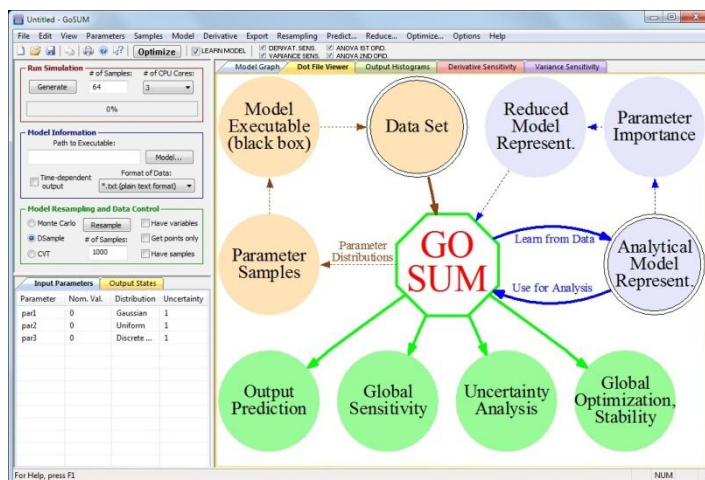
Who want to understand their models and data at a deeper level

AIMdyn's GoSUM Software provides a suite of tools for complexity reduction, including global sensitivity analysis, optimization, uncertainty analysis and model reduction

That offers the most comprehensive suite of design and analysis tools for complex engineered, socio-cultural or natural systems

Unlike the current fragmented tools for data analysis, model validation and verification, uncertainty and sensitivity analysis

GoSUM Software provides a closely integrated set of tools that allow for quick, deep insights based on a proprietary set of analysis techniques and visualization tools tuned to unravel the system complexity.



GoSUM software process flow;
dashed arrows indicate optional steps

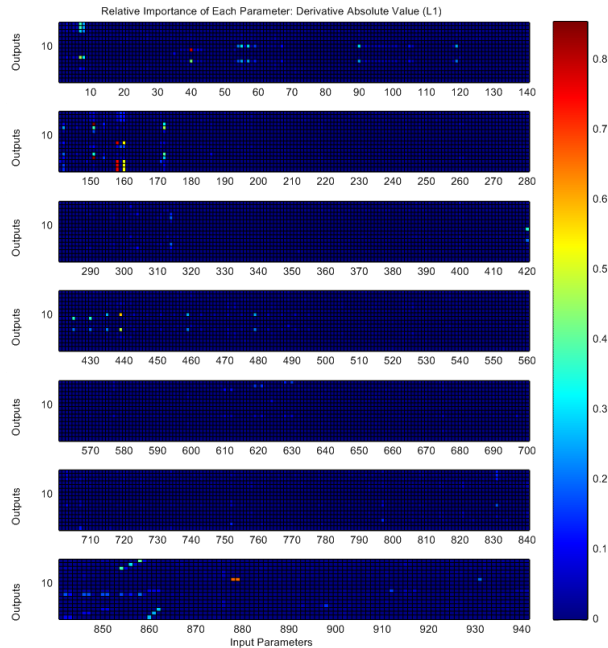
GoSUM can work from **observed data** or from a **model executable**. In both cases, an analytical representation of the data is formed.

Analytical representation allows for :

- rapid examination of the properties such as **sensitivity** to input parameters and **uncertainty** of outputs.
- detection of **optimal parameter values** for different cost functions and determination of **fault or instability regions**

GoSUM is based on some of the fastest available computational algorithms for nonlinear model representation and sampling, enabling simultaneous examination of literally 10's of thousands of effects on the **outputs of interest**. Due to fast computational algorithms, smaller problems (size 10-1000 parameters) can be examined with **unprecedented accuracy**.

GoSUM features comprehensive data analysis **visualization**, using easily interpreted **graphical representations**.

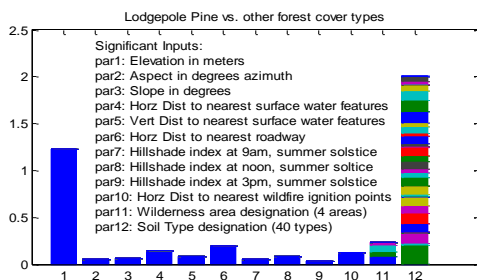
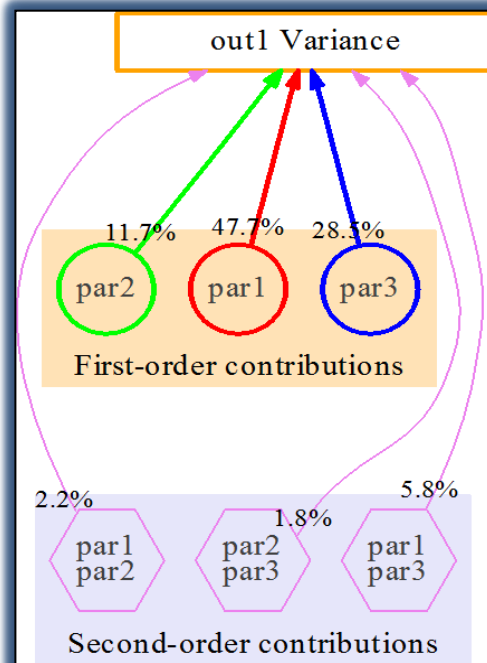


The “heat map” on the left represents the influence of 941 different parameters - plotted on the horizontal axes, in 7 rows - on 16 different outputs. Deep blue color indicates small influence, red indicates strong influence.

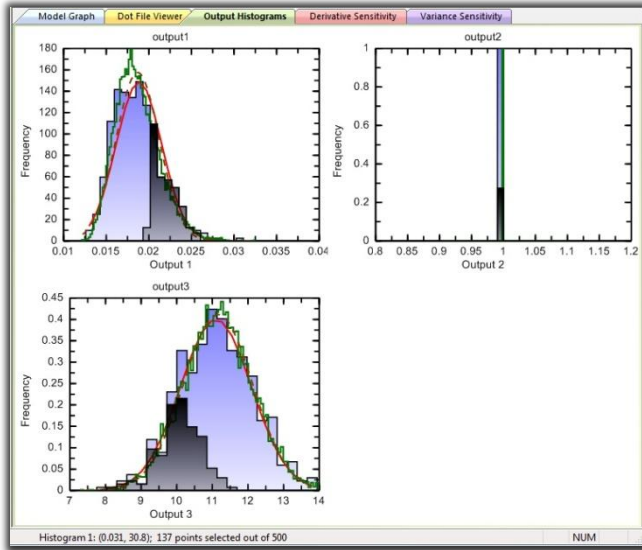
In many cases, such as in the one showed, GoSUM uncovers that only a few, out of thousands of possible influences, really matter. In that case a reduced model representation is possible.

GoSUM automatically finds both first-order, and higher-order (joint) influences of uncertainty in input parameters on outputs of interest. These are represented graphically in GoSUM as shown in the figure on the right.

GoSUM can treat, continuous, discrete or categorical variables as shown in the figure on the bottom¹.



¹ A bar chart represents factors that influence occurrence of lodgepole pine vs. other forest cover types. Parameters 11 (wilderness area) and 12 (soil type) are categorical variables.



GoSUM allows for easy selection of subsets of data

The histograms on the left show distributions of 3 outputs:

- **Blue** histogram (original data)
- **Red** curve (Gaussian fit for original data)
- **Green** curve (resampled data)
- **Brown** dash curve (Gaussian fit for resampled data)
- **Black** histogram (selected points, 137 points are selected)

- **GoSUM** can be run in **Command-Line Mode** using a configuration file.

[The figure on the right shows an example of learning a model from command line.](#)

- **GoSUM** supports **MATLAB** m-file functions and **Simulink** executables.

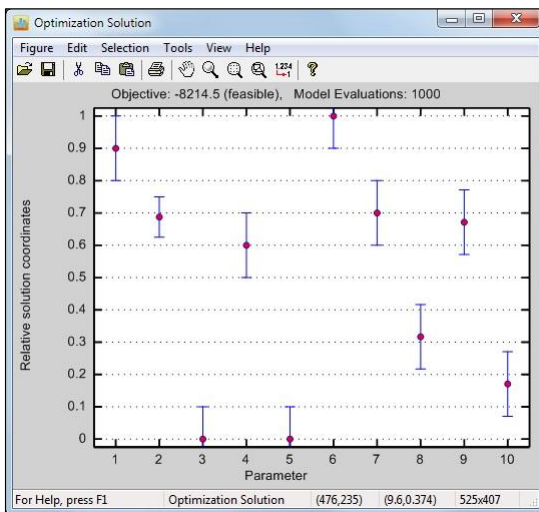
```

C:\Windows\System32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\Users\Xiaodan\Documents\Projects\windun_1\Uncertainty\64\Release>GoSUM.exe
-cf c:\Users\Xiaodan\Desktop\GoSUM_dev\config_file_templates\config_10.txt
C:\Users\Xiaodan\Documents\Projects\windun_1\Uncertainty\64\Release>
Content of parsed configuration file:

Anova1 = true
Anova2 = true
DerSens = true
ExponDistMaxRange = 2
GaussDistMaxRange = 5
VarSens = true
constraint = c:\Tutoria1\Example_1\constraints.txt
out_normal = false
exe_path = c:\Tutoria1\Example_1\Example1.exe
fast_points = false;
learnModel = true
learn_type = exe
model_path = C:\Users\Xiaodan\Desktop\GoSUM_dev\config_file_templates\
model_title = Model_test_10
nns_core = 3
nns_samp_points = 64
outname_path = c:\Tutoria1\Example_1\outnames.txt
param_path = c:\Tutoria1\Example_1\parameters.txt
task = learn_model

Task: learn_model
1) Done.
2) Done.
3) Done.
4) Done.
5) Done.
6) Done.
7) Done.
8) Done.
9) Done.
10) Done.
    
```



GoSUM can perform optimization by using **Multi-start Analytical Derivative-based** and **Adaptive Direct Search** methods on:

- **Analytical Models**
- **Models learnt in GoSUM**
- **Black-box Models**

The figure on the left shows optimization progress dialog while optimizing a model with 10 parameters.