Options and UTP RSM code plug-ins to iSIGHT and Options Optimiser Plug-In to Model Center

Tony Scurr (A.D.Scurr@soton.ac.uk)
Computational Engineering Design Group
School of Engineering Sciences
University of Southampton
Highfield, Southampton
SO17 1BJ

This article may be found at
http://www.soton.ac.uk/~cedc/posters.html

Objectives:

- To incorporate the OPTIONS optimisation, DOE and RSM algorithms into iSIGHT as a plug-in.
- To incorporate the UTP developed (Stephen Leary) DOE and RSM algorithms into iSIGHT as a plug-in.

iSIGHT Plug-ins:

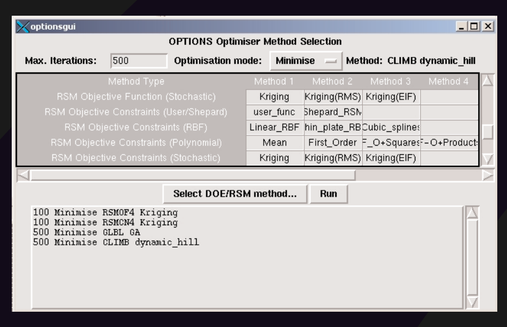
The following four things need to be done to add an optimisation technique (i.e., couple a code) to iSIGHT:

1. Provide two C routines (one through a .tgen file) to create a new Tcl package and Tcl command for the optimisation technique
2. Use ESI C API calls to communicate between the optimisation technique and iSIGHT
3. Use the Technique Generator (Techgen) utility to automatically create support code needed to add your technique to iSIGHT
4. Any GUI interfaces need to be programmed (in Tcl/Tk) & incorporated into the overall control structure.

Basis for iSIGHT plug-in development – the Tcl language:

- Tcl language consists of an interpreter that understands a base set of commands implemented in a C library.
- Tcl is powerful because it supplies a mechanism for extending the base command set with additional commands written in C or Tcl as dynamically loadable, shared libraries.
- This is the way iSIGHT itself is implemented.

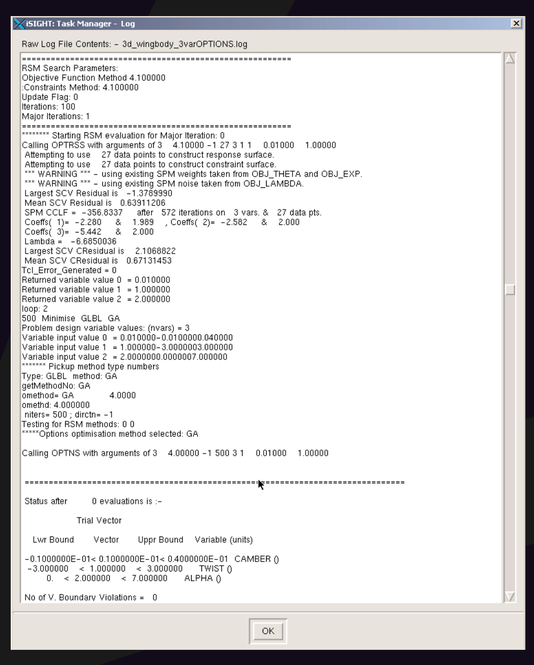
Options iSIGHT Plug-In GUI:



Run control parameters:
Maximum iterations: 500
Optimisation mode: Minimise
Last method selected: dynamic hill climbing

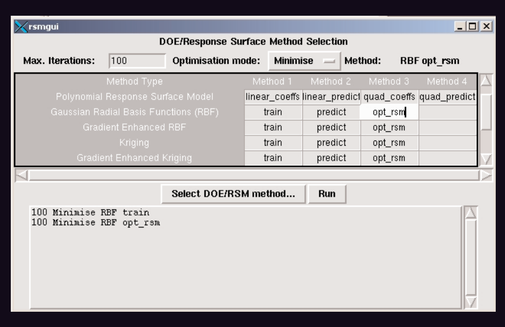
Optimisation, DOE and RSM methods available for selection (45+ DOE, RSM and optimisation algorithms).

Run schedule selected:
Build Kriging model of Objective Function and main constraint. Minimise Kriging predictor on objective function using GA followed by local search.



Run Task Log: showing building of objective function and constraint surfaces using Kriging, followed by a Genetic Algorithm (GA) optimisation.

UTP RSM Plug-In GUI:



Run control parameters:
Maximum iterations: 100
Optimisation mode: Minimise
Last method selected: RBF Optimise
RSM

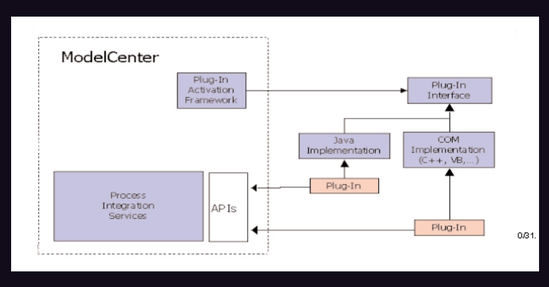
DOE and RSM methods including Polynomial, Radial Basis Function (RBF) and Kriging algorithms, the last two with gradient enhanced algorithmic versions.

Run schedule selected:
Train RBF to derive optimal sqsig parameter followed by building and optimisation of the RBF RSM surface.

The plug-in is implemented in the same way as the Options plug-in, i.e. using the iSIGHT Techgen utility. The plug-in contains a number of RSM methods, including Polynomial, RBF, Kriging, the latter two with additional gradient enhanced methods. The RSM methods only handle unconstrained objective functions and use their own internal Simulated Annealing (SA) based optimiser for model training and optimisation.

Options Plug-In for ModelCenter:

- Objective: Incorporate the Options optimisation package with its own GUI into ModelCenter, so that a problem defined in MC can be optimised using one or more Options methods and the results stored in an MC Data Collector for further display/processing by MC facilities.
- Phoenix supply a Developer's Guide for Plug-Ins to ModelCenter. A plug-In can be written as a COM component (using C++, VB, etc) or Java component (with Java Swing GUI)



ModelCenter Plug-In Interfaces:

- **Tools-Trade Study Plug-In:** a Trade Study can be any algorithm that repeatedly runs an analysis code to reach some objective (e.g. an optimization, DOE or parametric study).
- **Component Plug-In:** incorporate plug-in as a component in the Server Browser so that it can be included into Workflows. On the Workflow, click on component icon to bring up its GUI.
- **Data Collector Plug-In:** appears as a toolbar item in the Data Collector, and is run from there using data from the Data Collector. It is used for post-processing operations, such as building a response surface model.

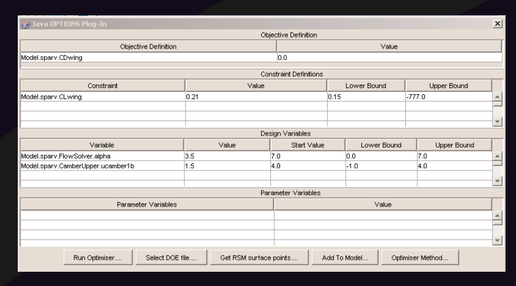
Some combinations of the above are valid, such as Trade Study + Component plug-in or Data Collector + Component plug-in.

Options Trade Study/ Component Plug-In:

What's involved:

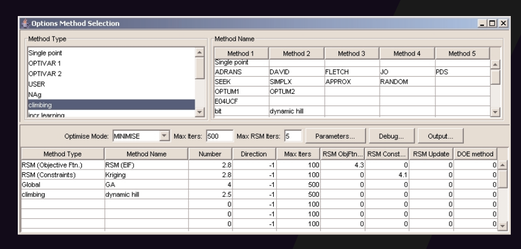
- Develop a Java plug-in program according to the Trade Study and Component interface requirements and the JavaBeans specification.
- Develop a series of table driven (JTable/JTableX) Java Swing based GUI interfaces to drive Options.
- Integrate the Options package (Windows version) as a DLL through the JavaOptions (JNI based) interface developed for the Geodise project.
- Package the plug-in as a JAR file and register the plug-in with ModelCenter.

Options Plug-In Model Set-up:



The main Options Plug-In GUI showing problem data and selection buttons to drive the optimisation through lower level GUIs.

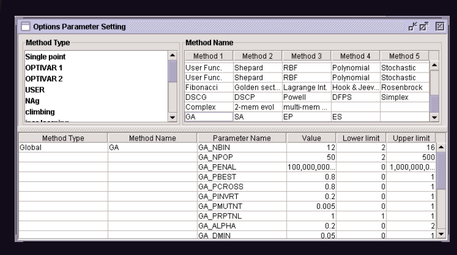
Options Method Selection (Scheduling) GUI:



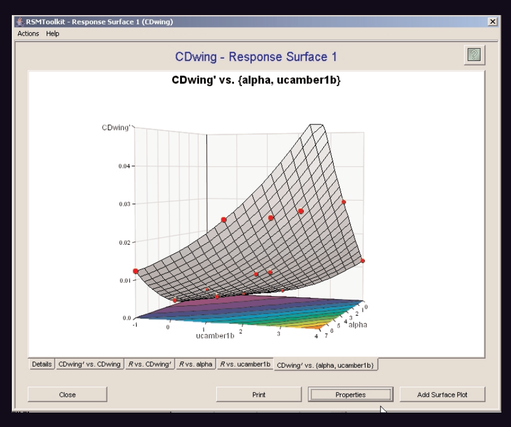
Sections:

- Optimisation, DOE and RSM methods available for selection (45+ DOE, RSM and optimisation algorithms).
- Run control parameters and buttons:
  - ✷ Optimisation mode: Minimise
  - ✷ Maximum iterations for next step: 500
  - ✷ Maximum major iterations (updates) for RSM models: 5
  - ✷ Call method selected parameter setting GUI
  - ✷ Display Options Debug output file
  - ✷ Display Options optimisation log file
- Run schedule selected:
  - ✷ Build Kriging model (using Expected Improvement Function) of the Objective Function and main constraint. Minimise Kriging predictor on objective function using GA followed by local search.

Options Method Parameter Setting:



Change running parameters for GA algorithm.



Use Model Center RSMToolkit to generate a plot of the response surface using data generated by the 'Generate RSM surface points' option in the main GUI.

University of Southampton