8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

# PROCESS OPTIMIZATION USING A SINGLE COMPUTATIONAL SIMULATION ENVIRONMENT

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**Key Words:** *FEA, Process Simulation, Control, Optimization, Temperature Control, Building Vibration Control.*

## ABSTRACT

As opposed to, the ever increasing generality of FEA codes, is the specific nature of the design processes and design information used within any single organization. Often this in-house information has been gleaned and "polished" over many years and can represent their competitive edge; clearly never to be divulged: like the formula for Coca-Cola; or my wife's stew. When the user has a single focus for the analyses and computational simulations required in their product; then, if they can configure a User Defined Simulation (UDS) of a "day-in-the-life" of that product, this can be very beneficial. Then rather than having the lengthy process of defining a new product and building an FEA model and analysing it, they have all this pre-programmed via an Application Programming Interface (API). In the API the whole model building and/or adaptation process can be programmed and then the lifecycle is choreographed, including a "bad hair day".

Such a UDS has the advantage that:: Time is saved; Redesign time for optimization and improvement is saved; Design performance exploration can be automated; Errors are eliminated; Training for new staff is improved; Standards are maintained.

Having generated a UDS the next stage of any process simulation is to ask how it can be made better; which parameters improve things, which do not. For the control of a new physical process much effort can be saved by having the controller optimized quickly in simulation mode.

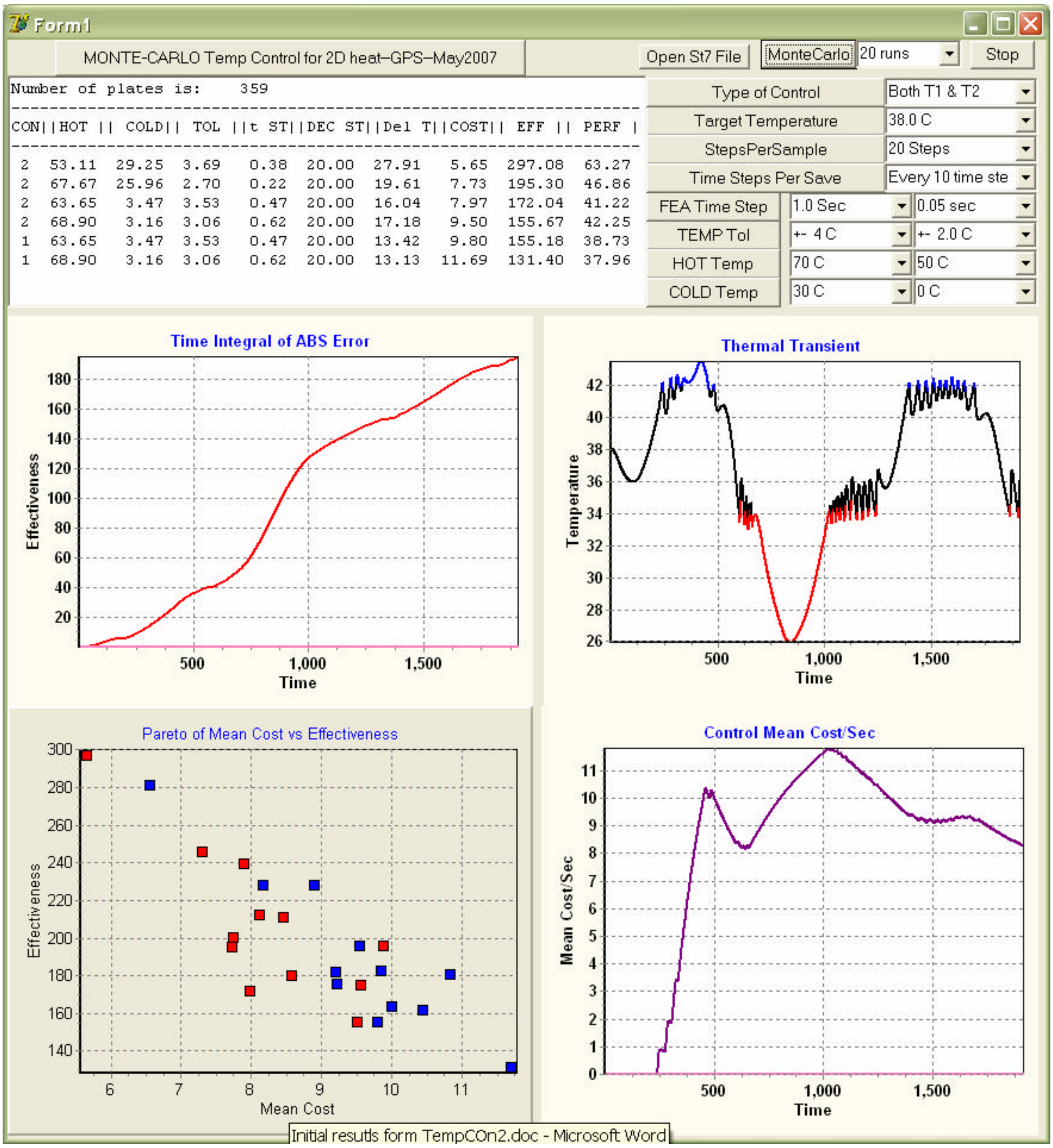
In the past the various ingredients of this process control simulation optimization resided in three separate and disparate software environments; an FEA code for the physical process; then a control code like Simulink, or Scilab to set controls and thirdly an optimization code such as ModeFrontier to drive the improvement cycles. This can be costly with difficult communications, and possibly not a time efficient way of achieving the desired outcome.

This presentation describes the development of an environment whereby the whole process control of a UDS and its optimization can all be done inside the one software

package, thus saving time, cost and the problems of integration.

This presentation describes the UDS process and how it can be implemented and modified using an API in a commercial FEA code and further to that, the process control can be explored to find the best operational settings. Two examples, drawn from the experience of the author are presented, including one whereby a control system is implemented and improved all in simulation mode.

The figure below is the GUI from the API for a simulated temperature controller with a Pareto front driven by a Monte-Carlo selection of control and simulation variables like FEA time step, target temperature, temperature of hot source, etc.. Behind all the control settings is the Strand7 FEA code acting as a computational engine. The presentation will describe the GUI and also give a real time demonstration of the whole system operating.



MONTE-CARLO Temp Control for 2D heat–GPS–May2007

```
Number of plates is:    359
------------------------------------------------------------------------------
CON||HOT || COLD|| TOL ||t ST||DEC ST||Del T||COST|| EFF || PERF |
------------------------------------------------------------------------------
 2   53.11  29.25  3.69   0.38  20.00  27.91   5.65  297.08  63.27
 2   67.67  25.96  2.70   0.22  20.00  19.61   7.73  195.30  46.86
 2   63.65   3.47  3.53   0.47  20.00  16.04   7.97  172.04  41.22
 2   68.90   3.16  3.06   0.62  20.00  17.18   9.50  155.67  42.25
 1   63.65   3.47  3.53   0.47  20.00  13.42   9.80  155.18  38.73
 1   68.90   3.16  3.06   0.62  20.00  13.13  11.69  131.40  37.96
```

| | | |
|---|---|---|
| Type of Control | Both T1 & T2 | |
| Target Temperature | 38.0 C | |
| StepsPerSample | 20 Steps | |
| Time Steps Per Save | Every 10 time ste | |
| FEA Time Step | 1.0 Sec | 0.05 sec |
| TEMP Tol | +- 4 C | +- 2.0 C |
| HOT Temp | 70 C | 50 C |
| COLD Temp | 30 C | 0 C |