Dylan Rinker

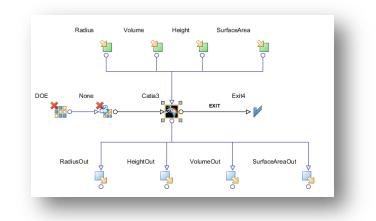
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How to do basic setup and optimization in modeFRONTIER.

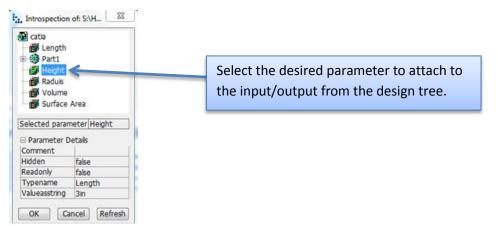
- 1. Open modeFRONTIER.
- Every modeFRONTIER program must begin with a "Scheduler" node, so select the scheduler node and drag it into the workflow space. This node, when put into the workflow space, will appear as two nodes: a DOE node and Scheduler.
- 3. Next drag in the CATIA V5 node
- 4. Every modeFRONTIER program must also end with a "Logic End" node 📝 , so drag that into the workflow (it is located in the drop down under the scheduler).
- 5. At this point the nodes can all be connected and it should look like this:



- 6. Next the CATIA file needs to be selected. Double click the CATIA node and CATIA Document Properties dialogue box will open. Under the Document option, browse for, and then select the part that you wish to optimize, and then click ok.
- Now it is time to select the inputs and outputs to your system. Drag an input node in for each of the inputs you would like to use, and connect them to your CATIA node. For every input node you need to also make an output node . You can name these accordingly and it should look like this:



8. Next go into the CATIA node again to connect each input and output node to a parameter in your part. To do this, double click on the CATIA node to open the CAITA Document Properties. At the bottom of this dialogue box should be the inputs on the left, and outputs on the right. Click the binoculars symbol in the blank field next to the input or output name. This will begin an introspection. Once the introspection is complete click close, and the design tree of your part will appear.



Double click the parameter in your design tree that you wish to link to each input and output. Do this for each input and output.

9. At this point you can also select the export and screen capture setting you want. In the CATIA Document Properties window you can expand Export option, and I suggest selecting "Model". This will export a CATIA model for each iteration of your optimization. Also, you can expand Screen Capture option and select to export an image with each iteration as well. Once the inputs, outputs, and export options are all set click ok.

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| OK Cancel Help | ОК | Cancel | Help | |

- 10. Now you need to set the boundary conditions for your inputs. Double click each input node and change the upper and lower bounds to narrow down the scope of your experiment and minimize infeasible results.
- 11. Similarly, set up an objective for each output. To do this, select the objective node and drag one under each output. Depending on your goal the objective can either be to minimize or maximize the output. Also, you may want to constrain an output, in which case you can drag a constraint node under the output (the constraint node is in the drop down of the objective node). Within the objective or constraint nodes you must select the "User Expression". To do this double click on an objective or constraint node and click on the little calculator symbol in the User Expression field. Select the variable you want, then click apply.

| Objective Properties - 4.3.0 b20101110 | 0.0% | 2 | |
|--|------------------|---|---------------------|
| Objective Properties | | | |
| Name | Objective30_2 | | |
| Description | | 2 | |
| Enabled | | | |
| Format | 0.0000E0 | | Click on the little |
| Objective Expression Properties | | | |
| User Expression | Node3axialOutput | | calculator symbol. |
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| Expression Editor | and a start of the | | 23 | |
|-------------------|--|---------------|--------------|--|
| Variables | Expression | | | |
| Node3axialOutput | 1 Node3axialOutput | | | |
| | | | | Make sure the Variable is in the Expression window, and is spelled |
| | Basic Functions | | Operators | exactly the same. |
| | sin cos | tan degToRad | | |
| | asin acos | atan radToDeg | | |
| | log In | exp sqrt | | |
| | abs sgn | rand pow | 7 8 9 / CA | |
| | ceil floor | round mod | | |
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| Apply | | | Cancel | |

12. Next you need to set your scheduler settings. Double click the DOE node. Under Space Fillers select Random. This is a good place to start with simple optimizations. Under parameters you can select the number of designs to start with. I picked 10.

| DOE Properties - 4.3.0 b20101110 | | X | J | |
|---|--|---|---|----------------------------|
| File Edit | | |] | |
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| Space Fillers Solution DOE Sequence | Random Design of experiments based on a rand a uniform distribution. the design space | | | Design of Experiment (DOE) |
| Incremental Space Filer Constraint Satisfaction | In esquence of points is determined Three parameters can be defined: 1) Number of experiments to be gen 2) Reject or accept unfeasible design 3) Random seed for sequence repeat It can be used as initial design populat | rerated; 15; tability. ion for MOGA and Simplex algorithm. | | |
| Robustness and Reliability Latin Hypercube - Monte Taguchi Orthogonal Arrays | The number of generated designs is lin Parameters Number of Designs [1,256000] Reject Unfeasible Samples Random Generator Seed [0,999] | 10 | | |
| Statistical Designs (a) Full Factorial Reduced Factorial | Add DOE Sequence | Stop DOE Sequence | | Number of initial designs |
| DOE Designs Table DOE Log | | | | |
| M CATEGORY Patheight 0 RNDODE 4.6176E2 1 RNDDOE 9.3551E2 3 RNDDOE 9.2741E2 4 RNDDOE 8.9439E2 5 RNDDOE -2.0565E2 | -3.3457E2 | A H | | |
| N. Designs:10 | N. Error Des.:0 | N. UnFeasible Des.:0 | | |
| ОК | Cancel | Help | | |

Once these two options are set, click Add DOE Sequence, and this will tabulate the initial designs for your experiment, then click ok.

13. Double click on the scheduler node that is connected to the DOE node and pick which algorithm you would like to use for your optimization. I picked MOGA-II.

| Optimization Wizard | 🗆 MOGA-II | 82 | 1 💽 🐴 | | | |
|--|--|---|-------|----|-----------|-----------------------|
| Schedulers | Scheduler based on Multi Ob designed for fast Pareto con | ective Genetic Algorithm (MOGA) | | | | |
| DOE Sequence | | lagencei | | | | |
| MACK | Main features: | laction and directional grass over | | | | |
| Lipschitz Sampling | Supports geographical se Implements Elitism for m | election and directional cross-over. | | | | |
| Sampling | | instraints by objective function penaliza | tion. | | | |
| Basic Optimizers | Allows Generational or St | teady State evolution. | | | | |
| SIMPLEX | 5) Allows concurrent evaluation | tion of independent individuals. | | | | |
| B-BEGS | The N (num, of individuals) e | ntries in the DOE table are used as the | | | | |
| Levenberg-Marquardt | problem's initial population. E | ach input variable base must be differer | | Se | lect vour | desired genetic algor |
| | from zero_since_MOCA_II-wa | to only with discrete variables. | = | | , | 8 8 |
| 🕈 MOGA-II | Parameters | | | | | |
| ARMOGA | Number of Generations [1 | ,5000] 50 | | | | |
| | Probability of Directional [0 | .0,1.0] 0.5 | | | | |
| 👹 Advanced Optimizers | Probability of Selection [0 | .0,1.0] 0.05 | | | | |
| NSGA-II | Probability of Mutation [0 | .0,1.0] 0.1 | | | | |
| MOSA | Advanced Parameters | | | | | |
| MOGT | DNA String Mutation Ratio [0 | .0,1.0] 0.05 | | | | |
| | Elitism | Enabled | - | | | |
| MOPSO | Treat Constraints | Penalising Objectives | - | | | |
| FMOGA-II | Algorithm Type | MOGA - Generational Evolution | - | | | |
| FSIMPLEX | Random Generator Seed | 0,999] 1 | | | | |
| Evolution Strategies | Category Parameters | | | | | |
| | | | | | | |
| Run Options RSM Options MO | RDO Options | | | | | |
| Run Options | | | | | | |
| Num. of Concurrent Design Eva | luations 1 | | | | | |
| Save Error Design in DB | | | | | | |
| Evaluate Repeated Designs | | | | | | |
| Save Repeated Design in DB | | | | | | |
| Evaluate Unfeasible Designs | | | | | | |
| Clear Design Dir on Exit | Never | | | | | |

- 14. At this point you should be able to run your program!
- 15. The experiment may take a while to run, but after it is complete you can use the information collected to choose an optimum iteration. To do this click on the Designs Space tab. In the Design Charts section of Tables and Charts click on Parallel Coordinate. Select the objectives that you would like to base this optimization on, and then it will bring up a graph consisting of a bunch of lines with a few vertical axes. Each vertical axis has objectives on it. Sliding the green arrow up and down the axes will eliminate or include different iterations. After narrowing down which iteration best fits your desired results you can select it and view the exported model, screen shot, and also run the exported CATScript to have CATIA automatically change your part to that iteration.