GENERAL PARAMETER SWEEP: A USEFUL MACRO

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Outline

➢ Motivation

➢ Basic features

➢ Step-by-step procedure

➢ Customizing the macro

➢ Running an illustrative example

➢ Conclusions

Motivation

➢ Built-in parameter sweep:
- Choose watches
- Run time-consuming simulation (hours and hours)
- Analyze results, and…
- …find out that other watches are of importance, too

➢ Now what:
- Run the time-consuming simulation over again
- In the meantime, write a macro saving complete project for each of the parameter combination

Basic Features

➢ Parametric sweep of up to six nested parameters
➢ Parameter values
  ▪ Stepped equidistantly, *or*
  ▪ Defined arbitrarily
➢ Each combination
  ▪ Stored as a complete project
  ▪ Renamed using a unique serial number
➢ Results
  ▪ Collected and sorted to
    • Disk folders
    • Navigation Tree (1D Results) – also anytime later
➢ No-nonsense approach (inputs by editing the VBA code)

Step-by-Step Procedure

Suppose having a project **MyFolder\myproject**

- ➤ Copy the sample macro file (*.mcr) to **MyFolder**
- ➤ Rename to define new item in **Macros** menu

  `myproject^My Name%My Param Sweep.mcr`
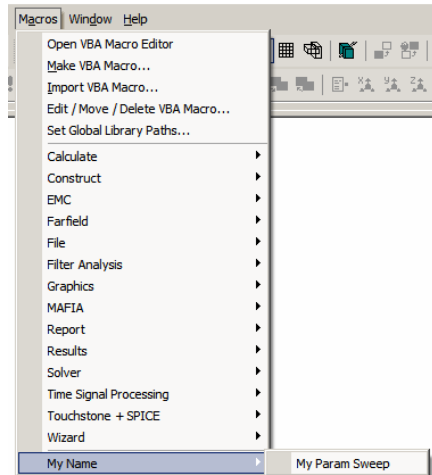
- ➤ Configure the solver
  - ▪ Appropriate ports, mode counts,…
  - ▪ To collect AR-filtered data: activate online ARF analysis
- ➤ Customize the macro
  - ▪ Macros>Edit…
  - ▪ Edit the inputs
- ➤ Test the macro
- ➤ Run the macro

Customizing the Macro

➢ Editing the VBA code

- Code section between
  INPUTS BEGIN

  •
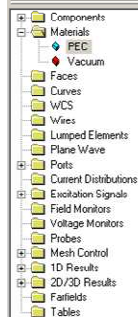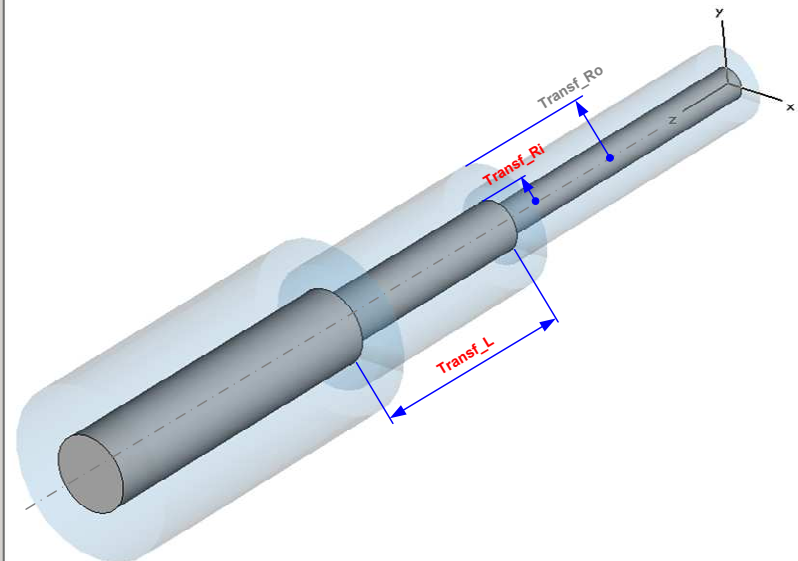
  •

  INPUTS END

- One other place in computation loop:
  - To skip computation for certain combinations
  - To compute only for certain combinations

CST MICROWAVE STUDIO - [steptrans]

File Edit View WCS Curves Objects Mesh Solve Results Macros Window Help

- Components
- Materials
  - PEC
  - Vacuum
- Faces
- Curves
- WCS
- Wires
- Lumped Elements
- Plane Wave
- Ports
- Current Distributions
- Excitation Signals
- Field Monitors
- Voltage Monitors
- Probes
- Mesh Control
- 1D Results
- 2D/3D Results
- Farfields
- Tables

Name	Value	Description	Type
Input_Ri	1.5	Input coax - inner radius	Undef
Input_Ro	3.5	Input coax - outer radius	Undef
Output_Ri	3.5	Output coax - inner radius	Undef
Output_Ro	8	Output coax - outer radius	Undef
Port_Dist	30	Port distance from matching section	Undef
Transf_L	21.01	Matching section - length	Undef
Transf_Ri	2.37	Matching section - inner radius	Undef
Transf_Ro	5.65	Matching section - outer radius	Undef

Transf_Ro
Transf_Ri
Transf_L

Material   = PEC
Type   = PEC
Therm.cond.= PTC

Global

Ready

steptrans   steptrans

Raster=20.000   Meshcells=7,986   PEC   mm   GHz   ns

Editing Inputs

1. Aborting macro run (solver does not respond to mouse clicks)

    CtrlFile is autocreated on macro start, contains string "bbreak". To stop macro after the simulation run in progress, EDIT the file to contain "break" (and save)

    CtrlFile="_CtrlFile.txt"

2. Test run on/off

    EDIT initially to TestRun=True to check if proper subdirectories are created and the parameters (info file) have the desired values. Then delete the subdirectories, set TestRun=False and run the macro

    TestRun=False

Editing Inputs

3. Swept parameter count

   `ParNum=3`

4. Swept parameter names

   EDIT parameter names. Only first ParNum are relevant.
      Letter case must be same as in Parameter List

   `ParNme(0)=`**`"Transf_L"`**

   `ParNme(1)=`**`"Transf_Ri"`**

   `ParNme(2)=`**`"Transf_Ro"`**

   `ParNme(3)=`**`""`**

   `ParNme(4)=`**`""`**

   `ParNme(5)=`**`""`**

Editing Inputs

5. Default parameter values

EDIT default param values (to be restored in case of regular end) It is safer to type numerical values from MWS Parameter List than using RestoreDoubleParameter function (for case of irregular end)

ParOrig(0)=21.01

ParOrig(1)=2.37

ParOrig(2)=5.65

ParOrig(3)=0

ParOrig(4)=0

ParOrig(5)=0

Editing Inputs

6. Parameter value counts

EDIT parameter value counts. Only first ParNum are relevant

ValCnt(0)=3

ValCnt(1)=2

ValCnt(2)=4

ValCnt(3)=0: ValCnt(4)=0: ValCnt(5)=0

7. Equidistant vs. arbitrary parameter values

EDIT flag to use equidistant values (True) or arbitrarily defined values (False)

Equidistant=True

Editing Inputs

8. Parameter values – equidistant

    if Equidistant, EDIT Start/Step values

    StartVal(0)=15 : StepVal(0)=5

    StartVal(1)=2.5 : StepVal(1)=0.25

    StartVal(2)=4 : StepVal(2)=1

    StartVal(3)=0 : StepVal(3)=0

    StartVal(4)=0 : StepVal(4)=0

    StartVal(5)=0 : StepVal(5)=0

Editing Inputs

9. Parameter values – arbitrary

```
if not Equidistant, EDIT Parray values

Parameter #1
Parray(0,0)=15:  Parray(0,1)=20:   Parray(0,2)=25
Parray(0,3)=0 '(0,3), (0,4), (0,5) irrelevant

Parameter #2
Parray(1,0)=2.5: Parray(1,1)=2.75

Parameter #3
Parray(2,0)=4:    Parray(2,1)=5
Parray(2,1)=6:    Parray(2,1)=7

Rest irrelevant
Parray(3,0)=0:   Parray(3,1)=0:    Parray(3,2)=0
Parray(4,0)=0:   Parray(4,1)=0:    Parray(4,2)=0
```

Editing Inputs

10. Ports and modes to collect results for

```
EDIT excitation port/mode and output ports/mode to collect
   results for (if any). Solver will not set them, hence
   appropriate mode counts for the ports must be set in
   solver before running the macro

InPort=1     'Excitation port to collect results for
InMode=1     'Excitation mode to collect results for

OutPortMin=1 'Min output port to collect results for
OutPortMax=2 'Max output port to collect results for
OutMode=1    'Output mode to collect results for
```

Editing Inputs

11. Starting serial number of simulation sequence

EDIT starting S/N of simulation sequence. Each simulation (project) is assigned a serial number, starting with 0. You can change it if you wish to merge more consecutive macro runs

i_ofs=0

Editing Inputs

12. Disk result folders/subfolders

```
EDIT folder name to which subfolders containing complete
    simulatios are stored

AllResDir="_AllResults"


EDIT subfolder of AllResDir where selected results of all
    simulations are gathered. Set to empty string ("") if
    no subfolder is required

ParSwpDir="_ParSweep"


EDIT: set True to sort individual output port results to
    separate folders

MakeSubSubDir=True
If OutPortMax=OutPortMin Then MakeSubSubDir=False
    'Option: disable in case of one output only
```

Editing Inputs

13. Results to collect

EDIT strings defining list of results
- **to be stored in ParSwpDir folder (WhichToCollect)**
- **to be added to 1D Results tree (WhichToTree)**

Add a corresponding letter to the string
Mind the letter case

<u>Normal results</u>
a=magnitude p=phase d=logmag (dB) s=signal

<u>AR-filtered results</u> (AR filter must be on in solver)
A=magnitude P=phase D=logmag (dB)

<u>Examples</u>
"sapdAPD", "AsDpaPd" (all results) "d" (only dB)

WhichToCollect="apdD"
WhichToTree="pdaPA"

Editing Inputs

14. Subproject numbering length

EDIT minimal subproject numbering length.

Set 0 for automatic.
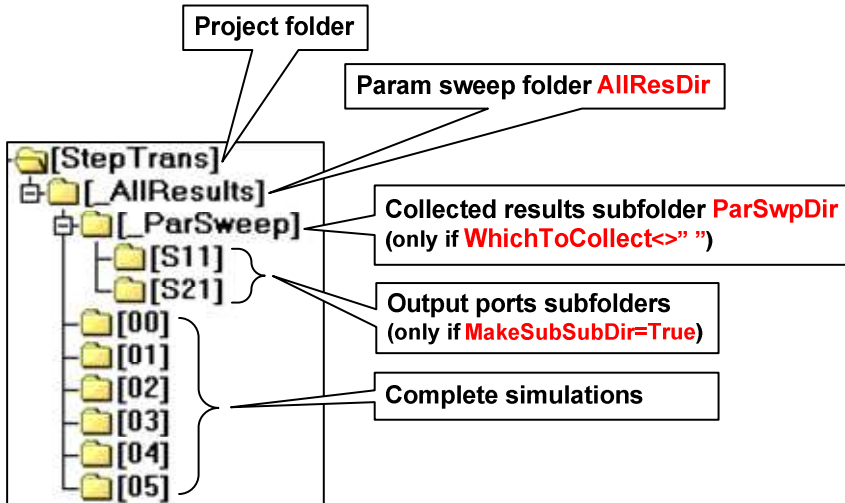
<u>Example</u>

- **Project MyProject**
- **Parameter combination No. 21**
- **MinNameLength=4**

Project will be stored
in folder MyProject_AllResults\0021
under the name MyProject_0021

MinNameLength=2

Folder Structure

Project folder

Param sweep folder **AllResDir**

[StepTrans]
[_AllResults]
[_ParSweep]
[S11]
[S21]
[00]
[01]
[02]
[03]
[04]
[05]

Collected results subfolder **ParSwpDir**
(only if **WhichToCollect<>" "**)

Output ports subfolders
(only if **MakeSubSubDir=True**)

Complete simulations

Editing Inputs

15. Only add data to **1D Results**

**EDIT: set to True if, after all simulations have been
completed, you only wish to add selected results
(defined by WhichToTree) to 1D Results tree**

OnlyTree=False

Editing Inputs

16. Skip some combinations, *or*
    Simulate only for some combinations

    - **Search for string "EDIT" below "INPUTS END" (in computation loop)**
    - **Use program flow control variable Skip**
    - **Define Skip in terms of sn = serial number of parameter combination**

    Example 1: Skip combinations 0 to 5 and 18 and 27
    Skip=False 'can always remain
    Skip=(sn<=5) Or (sn=18) Or (sn=27)

    Example 2: Simulate only for combinations in Example 1
    Calc=(sn<=5) Or (sn=18) Or (sn=27)
    Skip=Not Calc

    Skip=False

Illustrative Example

➢ Project *steptrans*
- ▪ Test-run the macro
- ▪ Final-run the macro
- ▪ Post-run the macro

Conclusions

- Useful tool to improve MWS functionality
- Supplements the built-in parameter sweep
- Complete subprojects
  - Can be deleted anytime later
  - One of them can be used as a new project
- Open to improvements by anyone
- Downloadable from
  - http://www.s-team.sk/files/?target=parsweep
    - This presentation (Ugm07-Bilik.ppt)
    - Sample project including the macro VBA file (StepTrans.zip)

Thank you!