



LIST OF NEW FEATURES

VERSION 8.0

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VisualDOC 8.0

VisualDOC 8.0 includes several major and minor changes aimed at improving the user-interface and performance as compared to version 7.2. The highlight of this release is Kriging model for response surface construction and a new ANSYS component which communicates data with the ANSYS Workbench software directly. The new ANSYS component does not require the user to manually specify how to read/write ANSYS data files. The following is the list of additions and enhancements in this release of VisualDOC.

Kriging Model

Kriging model is implemented in VisualDOC 8.0. The model is very flexible due to a wide range selection of correlation functions. It can be applied to approxiate many different and complex response functions. The Kriging model is added to the DOE approximation module as shown in **Figure 1**.

DOE Model
🔾 Linear
O Mixed: Linear + Interactions
O Mixed: Linear + Quadratic
Full Quadratic
Generation Forward Stepwise Regression
Kriging Model

Figure 1 Overview of DOE Model

Kriging model is composed by a regression model (polynomial function) and a stochastic correlation model. In VisualDOC 8.0, Kriging model includes five options for regression models which are constant, linear, linear plus interactions, linear plus pure quadratic, and full quadratic as shown in **Figure 2**. Also, it includes five options for correlation functions which are absolute exponential function, squared exponential/Gaussian function, generalized exponential function, linear function, and cubic function as shown in **Figure 3**. The detailed description of the regression models and correlation functions is presented in the UsersManual in Chapter 3.

Kriging Model					
Kriging Model Definition					
Regression Model	Constant 💌				
Correlation Model Constant					
Linear					
User Defined Kenniked.Linear+Pure Quadratic					
Regression Weights Full Quadratic					
Correlation Parameters (theta) 0.1					
Do not Optimize the Correlation Parameters (theta)					
Lower Bound of the	ta 1.0E-10 Ereate/Edit array for beta lower bound				
Upper Bound of theta 2.0 Create/Edit array for beta upper bound					
Minimum Number of Points for Selected Model : 1					

Figure 2 Options for Regression Model

Kriging Model					
Kriging Model Defin	ition				
Regression Model	Constant 💌				
Correlation Model	Squared Exponential/Gaussian				
User Defined Re	User Defined Re Absolute Exponential				
Squared Exponential/Gaussian					
Regression WeightsGeneralized Exponential					
Correlation Parame					
Do not Optimize the Correlation Parameters (theta)					
Lower Bound of the	ta 1.0E-10 Create/Edit array for beta lower bound				
Upper Bound of theta 2.0 Create/Edit array for beta upper bound					
Minimum Number of Points for Selected Model : 1					

Figure 3 Options for Correlation Function

In addition, the implemented Kriging model provides extra flexibility to the user for solving different problems.

- 1. The user can input the regression weights by checking the checkbox "User Defined Regression Weights (beta)" when using VisualDOC GUI or by leaving the beta array empty when using VisualDOC API. VisualDOC will not optimize regression weights in this case. The regression weights provided by the user will be used directly to build the model.
- 2. The user can define their own correlation parameters (theta) by checking the checkbox "Do not Optimize the Correlation Parameters(theta) when using VisualDOC GUI or by leaving the thetaLowerBound and thetaUpperBound array empty when using VisualDOC API. VisualDOC will not optimize the correlation parameters (theta) in this case. The correlation parameters provided by the user will be used to build the model directly.
- 3. For each parameter, the VisualDOC GUI provides a table that allows user to define the array with certain values that are different from the default value. It is very convenient for big system. For example, if user wants to define an array of theta with all the values to be 0.1 except one design variable which should be 0.2. In this case, the user only needs to insert 0.1 in the text box as default value, and then click the button "Create/Edit array for theta" to launch the table. Then inserts 0.2 in the row corresponding to the design variable and leave all the other rows empty as shown in **Figure 4**.
- 4. The Kriging model is available for VisualDOC API. The user needs to call DOE() method to build model and call krigResp() method to evaluate the response values for unknow points. The detailed description on how to use the Kriging model for VisualDOC API is presented in C_API in Chapter 2.

Kriging N	Model			
Kriging Model Definition				
Regression	Regression Model Constant			
Correlation	Correlation Model Squared Exponential/Gaussian			
🔽 User De	V User Defined Regression Weights (beta)			
Regression	Begreesien Weights (beta)			
Consolation				
Correlation	n Parameters (theta)	Create/Edit an	ray for theta	
Do no	嶚 🖈 🛛 theta Array	Define Table 🛛 🗸 🔨	⊗	
Lower Bo	Design Variable	theta	rer bound	
Upper Bo	Default Value	0.1)er bound	
	Wl			
Designs	W2	0.2	5	
⊖ Factori	W3			
🔾 Koshal	HI H2			
Simple:	H3		d l	
Options :		1	4	
Show A	The theta value corresponding to W1, W3,			
H1, H2. H3 is equal to default value 0.1				
OK Clear Cancel			1	

Figure 4 Correlation Parameters (theta) Setting Table

New ANSYS Component

The new ANSYS component is an integrated file IO component that talks directly to ANSYS Workbench. The property editor of the ANSYS component is shown in **Figure 5**.

Compared with File I/O component, the user does not need to create search/modify/extract actions by working with the .wbpj files, which is tedious and error prone in general. Instead, the user only needs to specify the location of the .wbpj file and click "LoadData" button. ANSYS component automatically parses and shows the input and output data in two separate tables as shown in **Figure 6**. The "Use" checkbox allows the corresponding data be added/removed from the database. The tool bar under the table

can be used to manipulate the data in the table. The "Select All" \exists icon and the "Deselect All" \exists icon allows the user to select or deselect all the data in the table.

The ANSYS component also supports both remote run and parallel run.

Run Location					
Analysis runs locally O Analysis runs remotely					
Analysis runs	s in pa	rallel			
Analysis Workin	ng Dire	ctory			
		Use the Model Directory			
Directory Path T	ype	pe 🔾 Absolute			
		○ Relative to Model Directory			
Directory Path					
Current Path		/home/lhe/Project/AnsysVdoc/exa	mple/palletLifterNew		
		Analysis	Configuration		
Local Analysis	Progra	m Definition			
-	Ab	solute			
File Path Type	🖲 Re	lative to Analysis Working Dir	ectory		
	⊖ En	vironment			
File Path					
Current Path					
Analysis Option	ns				
Program Argum	ents				Ø
Valid Beturn Co	ab	0			
	ue 				
Time Out (seco	nds)	0			
Extract Retu	rn Cod	e as output			
🗌 Terminate ta	ask exe	ecution if return code is invalio	ł		
Project File Defi	nition				
i roject i ne ben		solute			
File Path Type	Rel	ative to Model Directory			
File Dath	le nei	ative to moder birectory			
Current Path					
Template File					
File Name					LoadData
Parced Input Da	at a				Loggo ata
Farsed input Da	1.0	Name	Value		llse
			Value		000
Parsed Output Data					
		Name	Value		Use
Teet				FL I A	1
Test Sto	P			NG 1 T	- V

Figure 5 ANSYS Component Property Editor

Project File Definition						
O Absolute						
File Path Type	Relative to Model Directory					
File Path	palletLifter.wbpj					
Current Path	/home/lhe/Project/AnsysVdoc/example/p	alletLifterNew/palletLifter.wbpi				
Template File						
File Name palle	tLifter.wbpj.tmpl		LoadData			
Parsed Input Da	ata					
	Name	Value	Use			
🕞 🗋 mainCylinderBack_Thickness		0.1875	✓			
– 🗋 topJoint_Thickness		0.5625	×			
🗕 🗋 bodyL_Thickness		0.375	v			
 boxJointL_Thickness 		0.1875	2			
🛛 🗕 🗋 bottomJoint	- 🗋 bottomJointL_Thickness 0.6875 🗹					
armL_Thickness 0.5			✓			
Parsed Output	Data					
	Name Value Use		Use			
👝 🗋 total_Mass		8.641978369241	v			
— 🗋 max_Displacement		0.039363728724	2			
🕒 🗋 max_Stess		2063.974412497494	r			
lest Sto	p					

Figure 6 Parsed Data for ANSYS Workbench Project File

DOT 7.2

DOT Version 7.2 includes several enhancements of Version 6.0, most of which are minor. One important fix is that, in some cases, the final values of the constraints returned from DOT are not consistent with the final values of the design variables (the constraint values printed in the DOT output file are consistent). The major enhancement in DOT 7.2 is the ability to do multi-level optimization.

Multi-level optimization is useful in two key situations.

The first is where the sensitivity of the objective and constraints is markedly different such in combined shape and sizing structural optimization. Such problems may be difficult to solve considering all variables together. By separating them into two sets, the reliability of the optimization may be significantly improved.

The second situation where this is useful is in Multidiscipline Design Optimization, or MDO. For example, in designing an aircraft, the system level variables may include the shape of the fuselage and wings while sub-system variables include aerodynamic shape and structural sizing.

With this method, the gradients are required for all system and sub-system variables and all variables are included at the system level. This provides a search direction that is best for both levels of variables. Then, during the system level one-dimensional search, the sub-system optimization is performed in terms of the sub-system variables, including all system and sub-system constraints.

New Examples and Documentation

Four new examples showcasing the new and advanced features of VisualDOC have been added with this release. The new examples are as follows.

- 1. MixingElbow: This example showcases how to coupling ANSYS Workbench fluent simulation module with VisualDOC MDO options using the new ANSYS component.
- 2. PalletLifter: This example showcases how to coupling ANSYS Workbench mechanical simulation module with VisualDOC MDO options using the new ANSYS component.
- 3. beam_doe_Kriging: This example showcases how to set up the Kriging model in the DOE module to build the response surface. It also shows how to use the Kriging approximation model to perform optimization with the approximations.
- 4. chemical_process_conversion_API: This example showcases how to use VisualDOC API for DOE with Kriging model.

All the accompanying manuals have been updated for this new release.