## SimArk AI Builder 不确定量化仿真软件 V1.0

## 使用手册

#### 一、 软件介绍

1

SimArk AI Builder 不确定性量化仿真软件是一种重要的工程工具,用于 评估不确定性对系统性能和可靠性的影响。其关键技术涉及多个方面,包括 建模与参数化、随机过程建模、蒙特卡洛方法、灵敏度分析、不确定性传播、 以及结果解释与可视化等。功能介绍如下。

#### 1. 建模与参数化

能够对工程系统进行建模,并对系统中的各种参数和条件进行参数化, 以便在仿真中进行变化和分析。

#### 2. 随机过程建模

能够对系统中的随机过程进行建模,描述各种参数和条件的随机变化规律,如高斯过程、泊松过程等。

#### 3. 蒙特卡洛仿真

能够通过蒙特卡洛方法对系统的参数和条件进行随机抽样,并通过大量的仿真运算来估计系统的性能和可靠性。

#### 4. 灵敏度分析

能够对系统的性能指标进行灵敏度分析,评估系统性能对参数变化的敏感程度,帮助确定系统设计的关键参数和条件。

#### 5. 不确定性传播

能够对不确定性从输入传播到输出的过程进行分析,考虑参数之间的相 关性和影响,以准确地评估系统的整体不确定性。

#### 6. 优化与决策支持:

能够通过分析仿真结果,为工程系统的设计优化和决策提供可靠的数据 支持,降低项目风险,提高系统性能和可靠性。

具体用户操作界面执行过程及功能模块分类可以分为:

#### 1. Data(数据处理过程)

1.1 导入数据文件

导入 csv 文件数据进行可视化分析。

#### 1.2 DOE

2

能使用(Latin Hypercube Design)拉丁超立方、(Monto Carlo Sampling)蒙特卡洛采样等算法生成数据文件。

#### 2. Surrogated (代理过程)

能采用 Polynomical Chaos Expansion 代理模型对输入数据进行混沌多项式展开,得到代理模型计算得出的数据。

#### 3. Validate(验证过程)

能使用 Surrogate Validation 进行数据验证。

#### 4. Calibrate(校准过程)

#### 5. Analytics (分析过程)

能使用 Sensitivity Analysis (敏感性分析)、Uncertrainly Propagation (不确定性量化)对数据进行分析。

#### 6. Automate(自动化过程)

能够使用 Integration 集成工具,对不同模型的求解器进行自动化求解。

#### 二、 软件使用指南

软件安装成功之后,桌面会有相应的快捷方式。双击打开该软件,可以 打开软件主界面:

#### 1. Data (数据处理过程)

鼠标点击 File, 点击 New Project 菜单, 新建工程, 如下图。

File     Data     Surroghte     Validate     Calibrate     Predict       Sine     Analytics     Automate     Help       Sine     Project     Sine     Sine       Sine     Sine     Sine     Sine
See Project       Image: Save Project </td
Copen Project     Save Project     Save Ar     Save Ar     Save Ar
Save Project         Save As         Careers Files
Save As     Save As     Recent Files
Da Recent files
Settings
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SimArk Al Builder	Automate Unio	- 0
ation	Autonate : nep	
	New Project ? X	
	Project Name: Orplant	
	Project Name: Project Location: C/Usery/lida	
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	Project Name: Project Location: C/Userv/lista Cancel Submit	
	Project Name Project Location: C:/Userv/lista Cancel Submit	
	Project Name: Project Location: C/Usery/Isla Cancel Submit	
	Project Name Project Location: C/Userv/lista Cancel Submit	
	Project Name: Project Location: C/Userv/likia Cancel Submit	
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The Data Surgebe Validate Calibrate Pariel Adonate Heip           Station           Station           Station           Station	SimArk Al Builder	-	×
Smulatering Constants Smulatering Smulate	File Data Surrogate Validate Calibrate Predict Analytics Automate Help		
Surger	Simulation		
	File Data Surrogate Validate Calibrate Predict Analytics Automate Help		

## 在 Data 菜单栏,导入或者生成特定算法数据,如下图。

Data	Surrogate Validate	Cali	brate	Predict	t Analytics	Automate	Help	
u 🔣	Import From File	1						
₫	DOE •		Latin	Hypercu	ube Design	1		
	Subsample		Mont	te Carlo	Sampling			
	Data Exploration		Polyn	nomial C	haos DOE			
🛃 Ana	lytics							

点击 Latin Hypercube Design 使用拉丁超立方生成数据,如下图:

un Lutin Hypercube Di	congri			1	
Number Of Factors					
4					-
Factor		Lower Bound		Upper Bound	
X1		0		1	
X2		0		1	
X3		0		1	
X4		0		1	
Run Size					
Run Size 50 Generation Options		Rand	om		
Run Size 50 Generation Options Optional Summary		Rand	om		 
Run Size 50 Generation Options Optional Summary Factors		Rand Runs	om	Total Cells	
Run Size 50 Generation Options Optional Summary Factors 4	x	Rand Runs 50	om =	Total Cells 200	
Run Size 50 Generation Options Optional Summary Factors 4 Output Name	x	Rand Runs 50	om =	Total Cells 200	11
Run Size 50 Generation Options Optional Summary Factors 4 Output Name LHD	x	Rand     Runs     50	om =	Total Cells 200	

或直接导入数据,得到可视化界面如下图:

SimArk AI Builder 不确定后量化仿真软件 V1.0 5

	enorate pred		arytics Automa	te Help									
ion Data		X Cont	inuous										
X Continuous	750 x 10	Displa	nata 👘	Plot Sta	Transform	Modify Fi	le.						
Surrogate Validate		2	🧐 🙆 Smart		<b>A S</b>	86	- 4 0						
alibrate Analytics			Xt	X2	X3	X4	X5	X6	X7	X8	X9	X10	
		1	0.7195127	0.6220821	0.475133	0.584203	0.7735996	0.9392716	0.1682692	0.3830376	0.8006086	0.3392121	
		2	0.6260331	0.9136677	0.007362547	0.3043415	0.3038176	0.5633445	0.2947381	0.7758991	0.372547	0.7285518	
		3	0.5907564	0.5997393	0.3886821	0.7914195	0.2098904	0.1635858	0.5714128	0.6417011	0.5489002	0.3695794	
		4	0.3358843	0.5182772	0.7047647	0.2653491	0.8808121	0.7165219	0.5656612	0.3423753	0.3149123	0.5517781	
		5	0.1989849	0.5076476	0.6205394	0.2865177	0.1471429	0.6638936	0.5571798	0.8971535	0.6610928	0.5522983	
		6	0.582829	0.4641221	0.03265364	0.6358442	0.02007286	0.58983	0.239094	0.9458834	0.6210509	0.342893	
		7	0.6225698	0.2888348	0.8403901	0.183946	0.9246653	0.837711	0.7177302	0.2796907	0.02981467	0.2566966	
		8	0.3285493	0.8135026	0.9482576	0.5612589	0.09193701	0.3636185	0.1267543	0.4274433	0.06276832	0.05586171	
		9	0.6669145	0.6769149	0.4005579	0.1219579	0.09986841	0.6687934	0.8425746	0.1691766	0.4549213	0.5721857	
		10	0.3004387	0.1961251	0.4493969	0.6068491	0.7609778	0.1859142	0.1354617	0.7821289	0.05218491	0.6538893	
		11	0.535616	0.7107379	0.3808479	0.2951297	0.4765423	0.4720051	0.4549647	0.8054566	0.8090742	0.3549106	
		12	0.3024958	0.2609218	0.7356424	0.234526	0.4389634	0.147036	0.5078813	0.6107748	0.2829827	0.1838135	
		13	0.0523766	0.3536826	0.4626698	0.0232064	0.5665155	0.298334	0.1531589	0.4532645	0.8443185	0.009892626	
		14	0.06192188	0.625217	0.04376872	0.1395355	0.563856	0.5721097	0.260254	0.3634457	0.5087521	0.6243079	
		15	0.1930767	0.562312	0.8458536	0.2793074	0.4165693	0.1239088	0.4500514	0.01242428	0.373726	0.0607912	
		16	0.6199167	0.9473304	0.01684033	0.6333939	0.02895188	0.4937213	0.1811071	0.5806729	0.5393217	0.6464779	
		17	0.5316025	0.9953739	0.05862921	0.7204093	0.7161169	0.952314	0.3027462	0.9055772	0.8225556	0.2054782	
		18	0.549292	0.3108311	0.7755228	0.06033937	0.9512405	0.0806305	0.9641764	0.4053741	0.6913343	0.7862503	
		19	0.7786753	0.7450909	0.3119961	0.3703584	0.4361512	0.4932598	0.8205764	0.2050883	0.7087533	0.00314461	
		20	0.9171559	0.9198835	0.4422074	0.9809352	0.6456359	0.449044	0.458645	0.4811899	0.6725308	0.2329994	
		21	0.77446	0.8307666	0.4404331	0.1526709	0.5307435	0.4913367	0.004365633	0.08986602	0.312068	0.9838799	
		22	0.8249034	0.3918079	0.574142	0.2179152	0.1969548	0.2075744	0.4351719	0.32023	0.9396324	0.8566756	
		23	0.7101794	0.4037595	0.8372744	0.3365473	0.4713387	0.0533548	0.1734423	0.7457099	0.9816222	0.4751424	
		24	0.2275961	0.04808416	0.5046107	0.2925528	0.006601576	0.6508199	0.8719277	0.01501046	0.6129482	0.2705705	
		25	0.7546482	0.8608701	0.1419353	0.3777865	0.4250432	0.5091751	0.9454028	0.7731851	0.3358295	0.6113409	
		26	0.8507561	0.5873344	0.2650541	0.5689688	0.7710959	0.9047975	0.1751414	0.6923364	0.6505365	0.4047462	

点击右侧 Plot 视图可以切换数据视图界面,如下图:





点击右侧 Statistics 视图可以切换为数据基本分析视图,该视图包含了一些基本的数据分析如最值、平均值等,如下图:

Min         Max         Man         State           If Continuous         759 ±10         Plot         State/size         State/size           If Continuous         759 ±10         Min         Max         Man         State           If Continuous         759 ±10         X         00115636         0.999825         0.499954         0.28867           If Continuous         759 ±10         X         0.0115636         0.999825         0.499976         0.288650           If Continuous         X1         0.0019556         0.999827         0.590009         0.288650           X0         0.0004680         0.999977         0.500009         0.288650           X1         0.00049725         0.999823         0.500018         0.288676           X10         0.00049725         0.999977         0.500009         0.288650           X10         0.00049725         0.999977         0.500001         0.288676           X10         0.00049725         0.999974         0.500001         0.288676           X11         0.00017135         0.999899         0.50001         0.288676           X1         0.00017135         0.999899         0.50001         0.288771
■ Data         Pada         Pada         Statistics           ■ Continuous         750 x1         Min         Max         Mean         Statistics           ■ Surrogatic         750 x1         Min         Max         Mean         Statistics           ■ Surrogatic         750 x1         Min         Max         Mean         Statistics           ■ Surrogatic         750 x1         Min         Max         Mean         Statistics           ■ Calibratics         1000109595         0.999825         0.499997         0.288668           X3         0.00109595         0.999877         0.500009         0.288676           X3         0.000944726         0.999977         0.500009         0.288676           X0         0.000947126         0.9999151         0.500020         0.288676           X0         0.00048721         0.999151         0.500020         0.288678           X5         0.00043872         0.999151         0.500020         0.288678           X5         0.00043872         0.999151         0.500020         0.288679           X2         0.0011315         0.999898         0.500021         0.288679           X2         0.00111315         0.999889
min     Main     Main     Main     Std       B strongate     Volidate     0.0015636     0.999574     0.499964     0.28677       W Volidate     Volidate     Volidate     0.0015636     0.999828     0.499976     0.286638       X1     0.0016355     0.999877     0.499997     0.286638       X2     0.00064608     0.999977     0.50009     0.286655       X0     0.00064722     0.999812     0.50003     0.286648       X6     0.000247252     0.999815     0.50002     0.286656       X1     0.000247525     0.999151     0.50002     0.286656       X2     0.000171106     0.999895     0.4999982     0.286659       X1     0.000171355     0.999893     0.50001     0.286679
No         NX         0.00115036         0.999574         0.499964         0.28967           Validation © Validation © Analytics         NX         0.00115036         0.999574         0.499964         0.28967           X4         0.00109956         0.998825         0.499976         0.286680           X0         0.0004480         0.999977         0.50000         0.286655           X0         0.000447128         0.999813         0.500018         0.286654           X1         0.00046772         0.9999151         0.500008         0.286654           X5         0.000417326         0.9998143         0.500008         0.286659           X1         0.000417326         0.9999151         0.500008         0.286659           X2         0.000101335         0.999816         0.499982         0.286699           X2         0.000101335         0.9998899         0.500001         0.286701
¥4       0.0019956       0.998825       0.499976       0.288668         X1       0.0019535       0.998977       0.499997       0.288652         X3       0.00094408       0.999977       0.550009       0.288657         X1       0.00094408       0.999977       0.550018       0.288654         X10       0.00064722       0.999151       0.550008       0.288654         X10       0.00064872       0.999151       0.550008       0.288654         X5       0.000281562       0.999151       0.550008       0.288659         X1       0.000173106       0.998896       0.499982       0.288699         X2       0.00011335       0.998899       0.500001       0.288701
X0         Concessor         Concessor         Concessor         Concessor           X10         Concessor         Concessor         Concessor         Concessor           X5         Concessor         Concessor         Concessor         Concessor           X6         Concessor         Concessor         Concessor         Concessor           X6         Concessor         Concessor         Concessor         Concessor           X1         Concertsing         Concessor         Concessor         Concessor           X2         Concertsing         Concessor         Concessor         Concessor
Mai         000094808         0.999977         0.930009         0.288857           XH         0.000947326         0.99843         0.500018         0.288676           XH         0.000467726         0.99932         0.550028         0.288682           XS         0.000281562         0.999343         0.500028         0.288659           XL         0.000101335         0.999896         0.499982         0.288699           X2         0.000101335         0.999889         0.500001         0.288701
XN         0.000947126         0.999832         0.500023         0.298676           X10         0.00046772         0.99932         0.500023         0.298676           X6         0.00048712         0.999151         0.500024         0.288664           X6         0.00048712         0.999151         0.500024         0.288652           XS         0.00021562         0.59943         0.50002         0.288659           X1         0.000101335         0.999836         0.499982         0.288699           X2         0.000101335         0.999889         0.500001         0.288701
X10         0.00046772         0.99912         0.50023         0.288664           X6         0.00048721         0.999151         0.50008         0.288659           X6         0.0007552         0.999836         0.50002         0.288659           X1         0.0001713166         0.999836         0.499882         0.288659           X2         0.000101335         0.999889         0.50001         0.2885701
X6         0.000438721         0.999151         0.50008         0.288682           X5         0.00028562         0.99943         0.5002         0.28869           X1         0.000171106         0.999836         0.499982         0.28869           X2         0.000101335         0.999899         0.500001         0.288701
XS         0.000281562         0.99943         0.50002         0.288659           XI         0.000173106         0.999836         0.499982         0.28869           X2         0.000101335         0.999889         0.500001         0.288701
XI         0.000173106         0.998936         0.499982         0.288689           XZ         0.000101335         0.999889         0.500001         0.288701
XZ 0.000101335 0.999889 0.500001 0.288701

2. Surrogated (代理过程)

鼠标左键点击菜单栏 Surrogate 节点,选择 Polynomial Chaos Expansion, 创建 PCE 代理模型,如下图:



册 Po	olynomial Chao	s Expansion ?	$\times$
Input			
X Con	itinuous		~
Outpu	t		
Y Con	tinuous		~
Polync	omial Degree		
O To	otal Degree	Tensor Degree	
Polyno	omial Degree For A	All Inputs	
3			÷
	Factor	Distribution	
1	X1	Uniform[min=0.000173106,max=0.998936]	
2	X2	Uniform[min=0.000101335,max=0.999889]	
3	X3	Uniform[min=0.00106395,max=0.998977]	
4	X4	Uniform[min=0.00109956,max=0.998825]	
5	X5	Uniform[min=0.000281562,max=0.99943]	
6	X6	Liniform[min=0.000438721.max=0.999151]	
Total N	Number Of Polyno	mial Terms	
Deter	minsitic Calculatio	n Formula	
Penalt	y Term		
	Factor	Penalty	
1	Y1	None	
2	Y2	None	
3	Y3	None	
4	Y4	None	
Outpu	t Name		
PCE			
		Cancel	Submit

通过 PCE 代理模型计算得出的数据可视化如下图,可通过右侧控制栏视 图选择节点、控制输入的参数来查看想要的视图:





点击右侧 PCE Plot 节点视图,根据最右侧参数控制栏的输入情况,可以 计算得到不同的数据视图,如下:





#### 3. Validate(验证过程)

鼠标点击菜单栏的 Validate 节点,选择点击 Surrogate Validation,选择输入输出数据文件,如下图:

#### SimArk AI Builder 不确定后量化仿真软件 V1.0

开 S	imArk Al I	Builder						
File	Data	Surrogate	Validate	Calibrate	Predict	Analytics	Automate	He
Simu	lation		🕑 Surre	ogate Valida	tion	dation		
~ ⊞	Data		🕑 K-fo	ld Cross Vali	dation	immary	Plo	ot
	🆽 Х С	ontinuous1		750	x 10	Sammary		
	🖽 Y C	ontinuous1		75	0 x 4			
✓ ₹	Surrog	gate						
	<mark>₹</mark> PCI	E						
<b>~</b> 📀	Valida	te				1	:::::::::::::::::::::::::::::::::::::::	
	🕑 vali	idation				₩ 0.5	<u>19900</u>	
•	Calibra	ate				0		
4	l Analyt	tics						
							-	

点击 Submit 进行计算,如下图:

?	Х
	~
	~
	~
Cancel	Submit
	?

经过 validate 的计算过程,可以输出数据如下图:



SimArk AI Builder 不确定后量化仿真软件 V1.0 11

切换视图:



# SimArk AI Builder 不确定后量化仿真软件 V1.0 12

### 4. Analytics (分析过程)

鼠标点击 Analytic 节点,点击 Sensitivity Analysis,进入敏感性分析,如下图:

🗃 SimArk Al Builder	
File       Data       Surrogate       Validate       Calibrate         Surrogate	Analytics Automate Help Sensitivity Analysis Optimization Uncertainty Propagation

#### SimArk AI Builder 不确定后量化仿真软件 V1.0

13

Surrogate Model		
PCE		
Hyper Parameter		
Factor	Lower Bound	Upper Bound
X1	0.000173106	0.998936
X2	0.000101335	0.999889
X3	0.00106395	0.998977
X4	0.00109956	0.998825
X5	0.000281562	0.99943
X6	0.000438721	0.999151
X7	0.00115636	0.999574
X8	0.000964808	0.999977
Method Of Analysis		
Method Of Analysis Sampling Based Other Option Method Of Sampling LHD		
Method Of Analysis Sampling Based Other Option Method Of Sampling LHD Number Of Replications		
Method Of Analysis Sampling Based Other Option Method Of Sampling LHD Number Of Replications 4		
Method Of Analysis Sampling Based Other Option Method Of Sampling LHD Number Of Replications 4 Sample Size Per Replication		
Method Of Analysis  Sampling Based  Other Option  Method Of Sampling  LHD  Number Of Replications  4  Sample Size Per Replication 2000		
Method Of Analysis Sampling Based Other Option Method Of Sampling LHD Number Of Replications 4 Sample Size Per Replication 2000 Output Name		

选择 Surrogate Model 为 PCE,分析方法点击 Sampling Based 基于采样分析,选择 Number Of Replications 个数和 Sample Size Per Replication 样本大小,点击 Submit 进行计算,结果如下图:

SimArk AI Builder 不确定后量化仿真软件 V1.0 14

a Surrogate Validate Calibrate Pres	dict Analytics Auto	omate Help										-	
1	title	and they										Sa	
ta	Table Piot												
X Continuous 750 x 10 X Continuous 750 x 4	¥1(main effe	ects) ¥1(total effects)	Y2(main effects)	Y2(total effects)	Y3(main effects)	¥3(total effects)	Y4(main effects)	Y4(total effects)					
rrogate	X1 0.0473194	4 0.0982844	0.689034	0.698653	0.85285	0.882058	0.0498216	0.151742					
PCE	X2 0.12658	0.102236	0.146015	0.158369	5.16957e-05	5.10665e-06	0.0776852	0.167976					
validation	X3 0.0161123	3 0.0941864	0.0721039	0.0677129	-5.94327e-05	4.29125e-06	0.0809642	0.173313					
brate	X4 0.118628	0.101844	0.0351395	0.0374992	0.0446817	0.0603801	0.0487124	0.131653					
SensitivityAnalysis	XS 0.174985	0.0890121	0.0208104	0.0236679	-5.31992e-06	1.346e-05	0.0662367	0.152077					
	X6 0.107154	0.105152	0.0168582	0.0159491	0.0517877	0.0605906	0.0606259	0.137479					
	X7 0.076721	0.108385	0.011615	0.0121037	0.0345772	0.0513757	0.072364	0.16733					
	x8 0.250199	0.109609	0.00923162	0.0093151	0.0123229	0.0124408	0.0485721	0.13377					
	X9 0.128179	0.100464	0.00735612	0.00729744	0.000121526	4.2131e-06	0.0530671	0.132145					
	X10 0.0335904	0 108024	0.00557898	0.00605304	493773e-05	4.47612e-06	0.037224	0 153363					



鼠标点击 Analytic 节点, 点击 Uncertainly Propagation, 进入不确定性量化, 如下图:

-	~
	÷.
	•
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册 Unce	rtainty Propagation		?	×
Surrogate	Model			
PCE				~
Distributio	on Setting			
O Samp ○ Data I	le From Matrix			
Factor Dis	tribution			
	Factor	Distribution		
1	X1	Uniform[min=0.000173106,max=0.998936]		
2	X2	Uniform[min=0.000101335,max=0.999889]		
3	X3	Uniform[min=0.00106395,max=0.998977]		
4	X4	Uniform[min=0.00109956,max=0.998825]		
5	X5	Uniform[min=0.000281562,max=0.99943]		
6	X6	Uniform[min=0.000438721,max=0.999151]		
7	X7	Uniform[min=0.00115636,max=0.999574]		
8	X8	Uniform[min=0.000964808,max=0.999977]		
Aleatoric	Sample			
500				-
Output Na	ame			
Uncertain	tyPropagation			
		Cance	I S	ubmit

设定好参数后点击 Submit,得到结果如下图:

SimArk Al Builder	alibrate Dradi	et An	slutice Autor	nate Melo													-						
mulation	anorate Preur	LL MIL	arytics Autor	nate neip																			
Data		Uni	certainty Propi	agation														Sav	6				
X Continuous	750 x 10	Su	ummary Ev	raluated Point	5 Input Se	ting																	
Y Continuous	750 x 4		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	¥1	¥2	¥3	¥4							
PCE		1	0.5283095	0.9586123	0.2321276	0.9902558	0.3098256	0.9232	0.1599832	0.1875563	0.477433	0.7621067	-18.75545	0.4855725	77.86953	1238.71							
Validate		2	0.8620901	0.7449301	0.2483023	0.1727306	0.4047555	0.3184582	0.8025363	0.7965281	0.6383282	0.8164454	-18.53091	0.531595	107.6405	13152.85							
Calibrate		3	0.4154683	0.8923544	0.3592272	0.2978616	0.0204869	0.9737234	0.3613413	0.03830071	0.4235434	0.2691345	-19,13977	0.3550504	37.16678	11308.73							
Analytics     SensitivityAnalysis     IncertaintyPromagation		4	0.4040813	0.02898179	0.2759255	0.2819317	0.7778235	0.5271962	0.09191395	0.8068307	0.5918566	0.5670809	-18.95853	0.2363166	60.98734	11969.99							
		5	0.9043193	0.7059801	0.5617211	0.2563114	0.799164	0.5129363	0.4093672	0.2789732	0.7831603	0.6978182	-18.3466	0.5673458	113,8949	15419.08							
-		6	0.5192447	0.4646126	0.6804315	0.1431091	0.666932	0.9781002	0.4055522	0.3025498	0.08477527	0.2763687	-18.95956	0.3478935	42.91247	16116.23							
		7	0.5167855	0.4163889	0.1813956	0.3540381	0.7198399	0.3382485	0.4587645	0.9825033	0.4913487	0.1086145	-18.85187	0.303201	76.54903	11901.09							
		8	0.3446563	0.3637649	0.4490373	0.1361292	0.5082172	0.2675649	0.6589482	0.1682467	0.6403452	0.6441722	-18.87405	0.215259	39,16046	22142.67							
		0	0.2171223	0.7451671	0 2087657	0.8899506	0.3854015	0 8408300	0.4420955	0.855.41	0.1243466	0.0487072	-18 6813	0 3766682	38 1485	4595 143							
		10	0.7576279	0.0106222	0.2257518	0.7926921	0.2456274	0.6101040	0.2661596	0.0491027	0.6659311	0.1420022	10.0013	0.5700002	129.0001	6720.0							
			10	0.7570570	0.3100222	0.3237310	0.7020021	0.2450274	0.010100805	0.3001300	0.5461027	0.00340370	0.1450032	10.01743	0.3307355	1203031	17530.76						
				0.3110034	0.2235753	0.01450585	0.7942909	0.2592975	0.09190895	0.5559295	0.1459440	0.09540279	0.4905005	-19.01745	0.15/7205	50.03789	7034.000						
		12	0.9382453	0.125461	0.04507474	0.9238536	0.9080462	0.0414/155	0.1167523	0.3856615	0.06057982	0.2918173	-19.71882	0.5261671	218,2979	-7824.525							
						13	0.3584829	0.8261727	0.3589929	0.4187397	0.9015218	0.964902	0.7771291	0.9131635	0.9105913	0.3116204	-18.48772	0.453674	36.16321	18915.27			
				14	0.006234454	0.2272488	0.4140467	0.8539919	0.6666746	0.2234121	0.4968431	0.4014245	0.3559754	0.8157224	-18.98408	0.2241196	21.40838	9555.389					
				15	0.5932811	0.8548381	0.2135264	0.5684915	0.589896	0.3567795	0.980488	0.975011	0.5389799	0.9687091	-18.46274	0.4908069	79.35187	17137.21					
		16	0.1546013	0.3985258	0.1321547	0.2511022	0.8514337	0.1047748	0.6986377	0.1089241	0.07714307	0.7619316	-19.44962	0.185566	25.72537	8412.397							
		17	0.4264353	0.4860143	0.7757625	0.5607669	0.3687826	0.2953751	0.5693914	0.8086364	0.3284568	0.4350912	-18.49186	0.3309704	65.21912	22556.95							
		18	0.2077494	0.9249897	0.8267208	0.06284976	0.3614205	0.4483806	0.901997	0.9258144	0.4781257	0.008819214	-19.0566	0.4116576	25.6243	-1843.565							
		19	0.9156469	0.8160557	0.253731	0.827482	0.09316411	0.5564996	0.3091839	0.6135496	0.285671	0.2406435	-18.78388	0.5687075	162.3981	\$535.38							
		20	0.02323133	0.2795712	0.1893467	0.1444331	0.419068	0.2291244	0.8357888	0.8943598	0.1102602	0.9857668	-19.36118	0.1850341	16.85317	-3266.884							
		21	0.4513472	0.3988147	0.6378444	0.01159269	0.3156448	0.9251832	0.04782263	0.3828513	0.510981	0.3192871	-19.14245	0.2792104	41.92031	13972.76							
		22	0.3368933	0.6920726	0.6284806	0.1126187	0.2484112	0.4834638	0.3637422	0.8211983	0.4868171	0.5327528	-18.71525	0.3005643	43.24468	18276.12							
		23	0.1822807	0.472941	0.8671482	0.8587503	0.7391946	0.9232855	0.6663241	0.04437376	0.3889009	0.9693171	-18.73493	0.4036393	25.7067	9867.323							
		24	0.9507257	0.03486501	0.5944138	0.01144207	0.1485099	0.2453027	0.4737811	0.3977858	0.1565115	0.01512011	-19.77843	0.474943	122.5827	3552.767							
		25	0.2985628	0.01339109	0.9948085	0.2682933	0.7908559	0.1410156	0.5740367	0.7268062	0.6547071	0.2864385	-18.99688	0.3154479	45.18442	10594.2							
		26	0.203736	0.5732458	0.9069546	0.2418979	0.2450113	0.7512344	0.8797024	0.1927753	0.4976522	0.6562886	-18.69704	0.3328551	20.21842	9195.676							
		27	0.8484635	0.1227695	0.1056933	0.1495227	0.5288701	0.6293176	0.1225748	0.003852292	0.8514324	0.9072864	-19,23975	0.4339107	99.64715	350.987							
				0.0537005	0 1000047	0.3074447																	



## 5. Automate(自动化过程)

鼠标点击菜单栏 Automate 节点,点击 Integration 集成工具,选择需要的求解器,如下图:

e Data Surrogate Validate Calibrate Predict Ana	lytics Automate Help
nulation  Data  Surrogate  Validate  Calibrate  Analytics	<ul> <li>Integration</li> <li>Standard</li> <li>Adaptivtity</li> </ul>

The Integration		?	×
Input data			
X Continuous1			~
Integration type			
D:/Project/DevelopProcess/cfdBatch_20240424/tool/cfdB	Batch.exe		
Output name			
Integration			
	Cancel	Subm	it

点击 Submit 按钮,求解过程会后台运行,后台运行完后会更新到左侧的 Data 节点里,

如下图:

🗃 SimArk Al Builder					
File Data Surrogate Validate Calibrate	Prec	dict Analytics A	utomate Hel	р	
Simulation		Integration(1)			
✓		Data	Plot	Statistics	
Image: With State S	x 10 ) x 4 ? x 3	Display	imart ~	Sort Tran	Isform Modify File
<ul> <li>✓ Z Surrogate</li> <li>Z PCE</li> </ul>		Tavg	Tmin	Tmax	
<ul> <li>✓ Solution</li> <li>✓ Validate</li> <li>✓ Validation</li> </ul>		2 293.84	293.15	299.99	
<ul> <li>Calibrate</li> <li>Analytics</li> <li>SensitivityAnalysis</li> </ul>					