



Institute of Design Optimization

V7R5 RecurDyn/AutoDesign의 신뢰성해석 모듈 소개

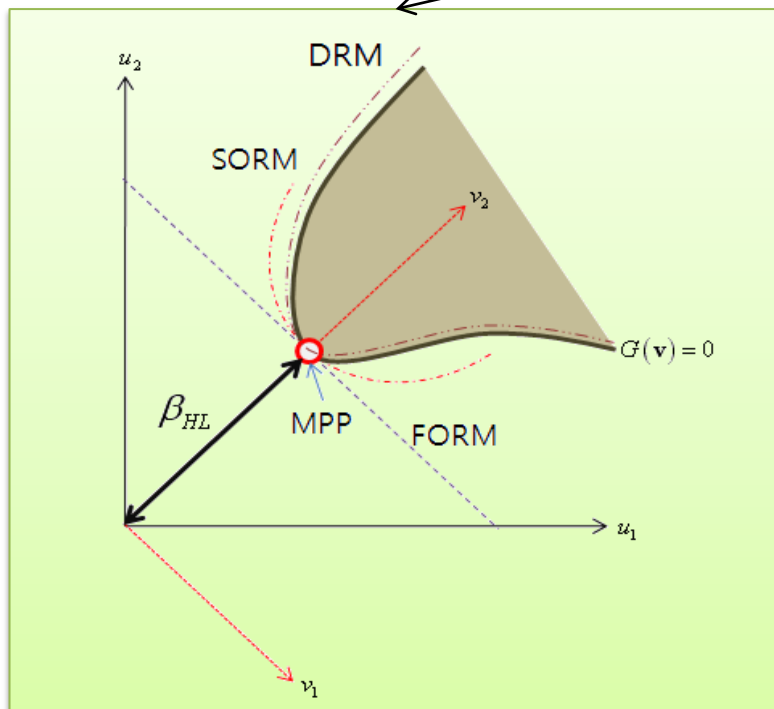
2010년 10월 14일
(주) 최적설계 연구소
강대오

- 1** Introduction of Reliability Module in V7R5 RecurDyn/AutoDesign
- 2** Reliability based Design Optimization Process using AutoDesign
- 3** Example Problem

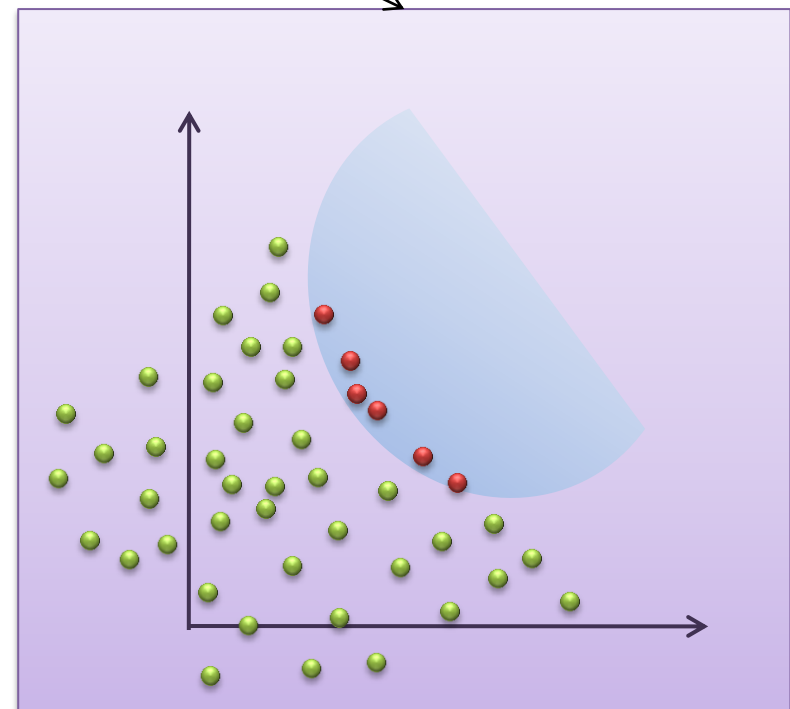
1

Introduction of Reliability Module in V7R5 RecurDyn/AutoDesign

Introduction of Reliability Module



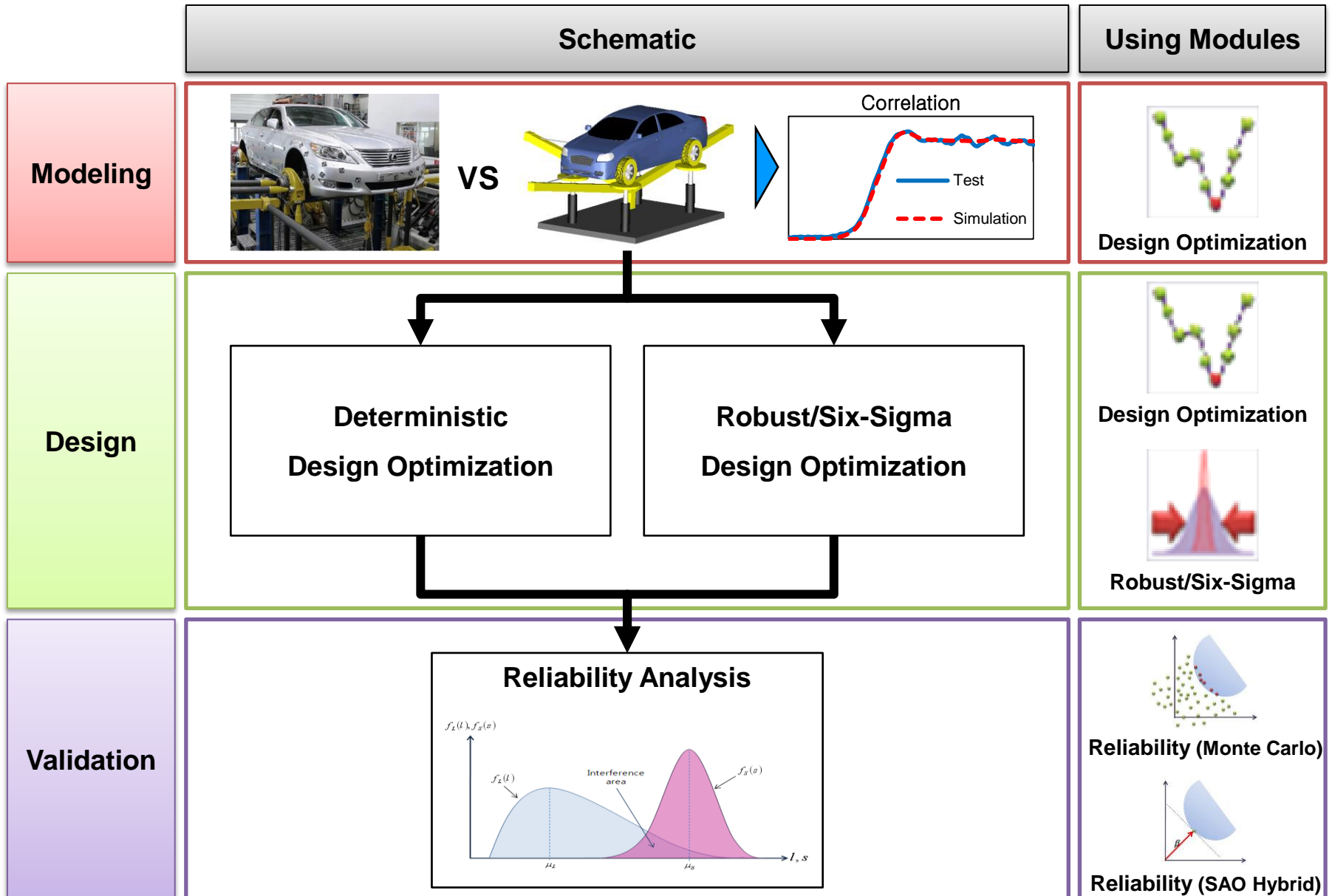
SAO Hybrid Methods



Monte-Carlo Methods

2

Reliability based Design Optimization Process using AutoDesign

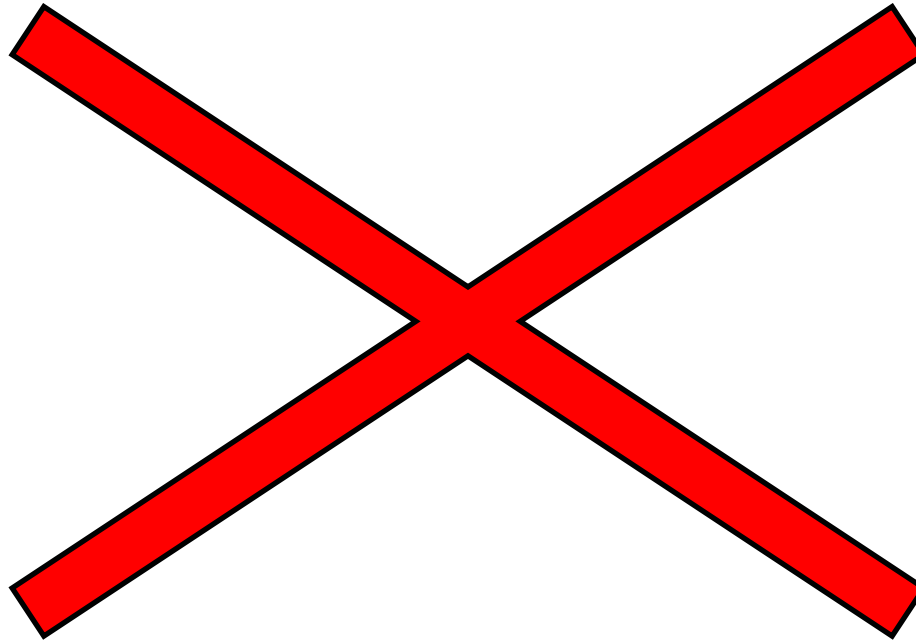


3

Example Problem

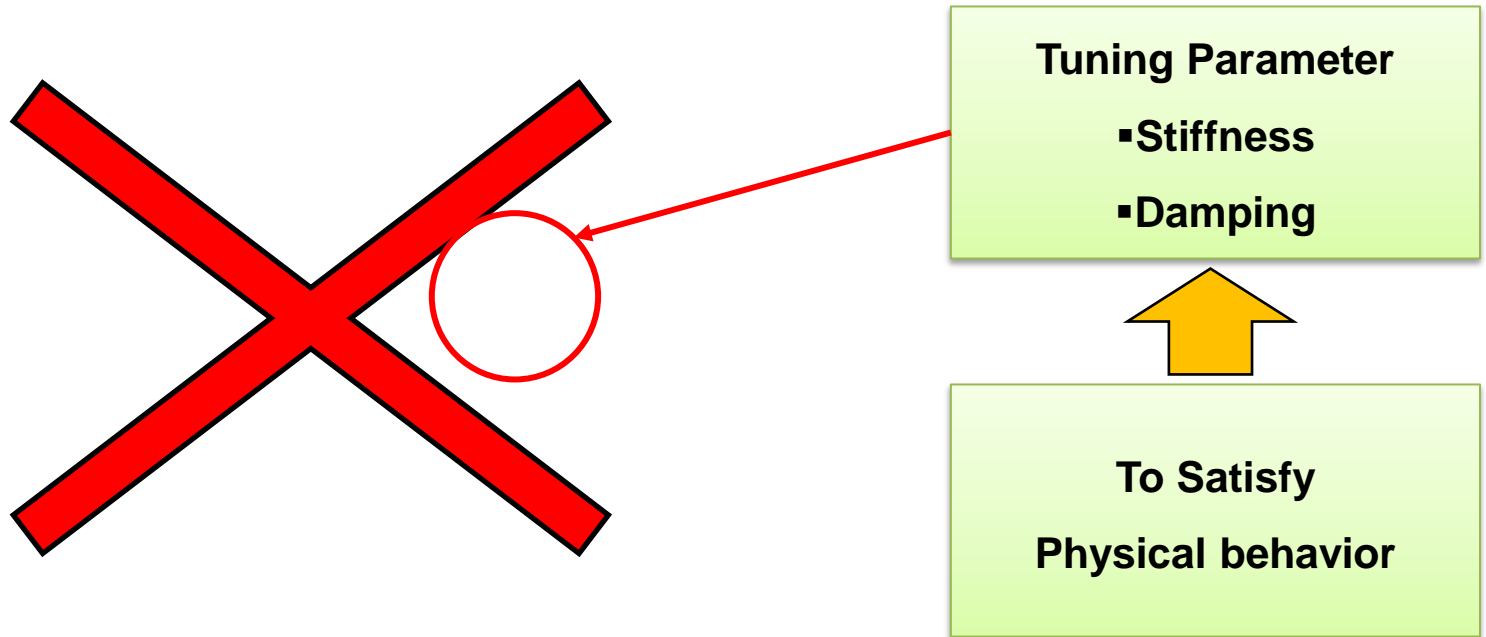
- ▶ **Problem Description**
- ▶ **Model Calibration**
- ▶ **Deterministic Design Optimization**
- ▶ **Robust Design Optimization**
- ▶ **Validation based on Reliability**

3.1 Problem Description



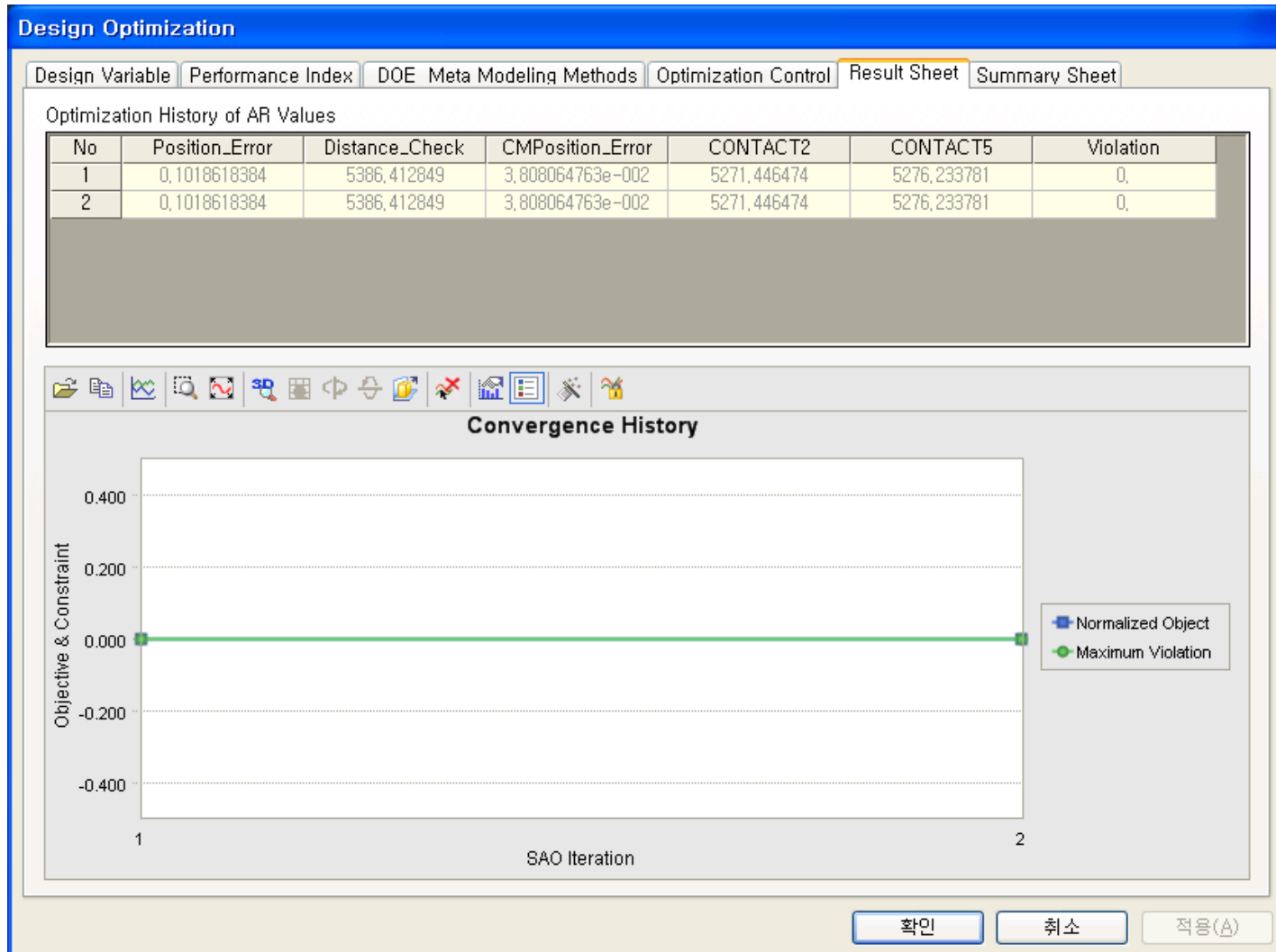
3.2 Model Calibration

- **Contact Parameters의 튜닝(1/3)**
 - Tuning parameter & Performance Index 설정



3.2 Model Calibration

- Contact Parameters의 튜닝(2/3)
 - Convergence History

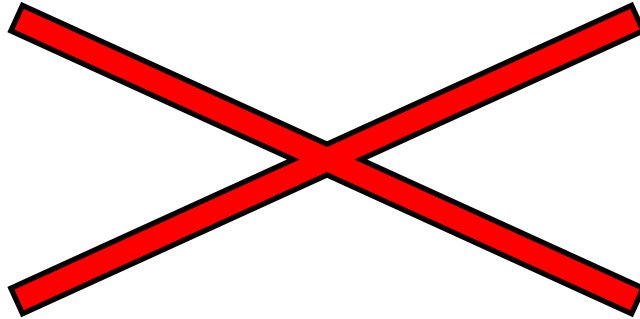


3.2 Model Calibration

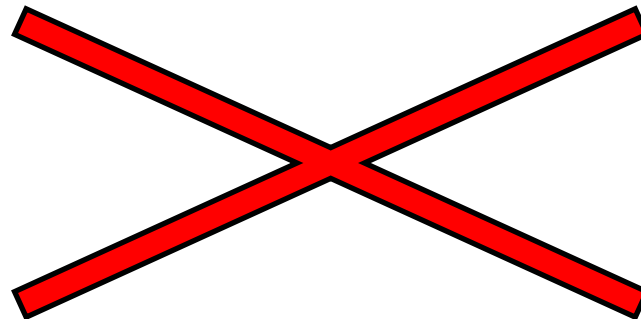
- Contact Parameters의 튜닝(3/3)

- Results

Before Tuning

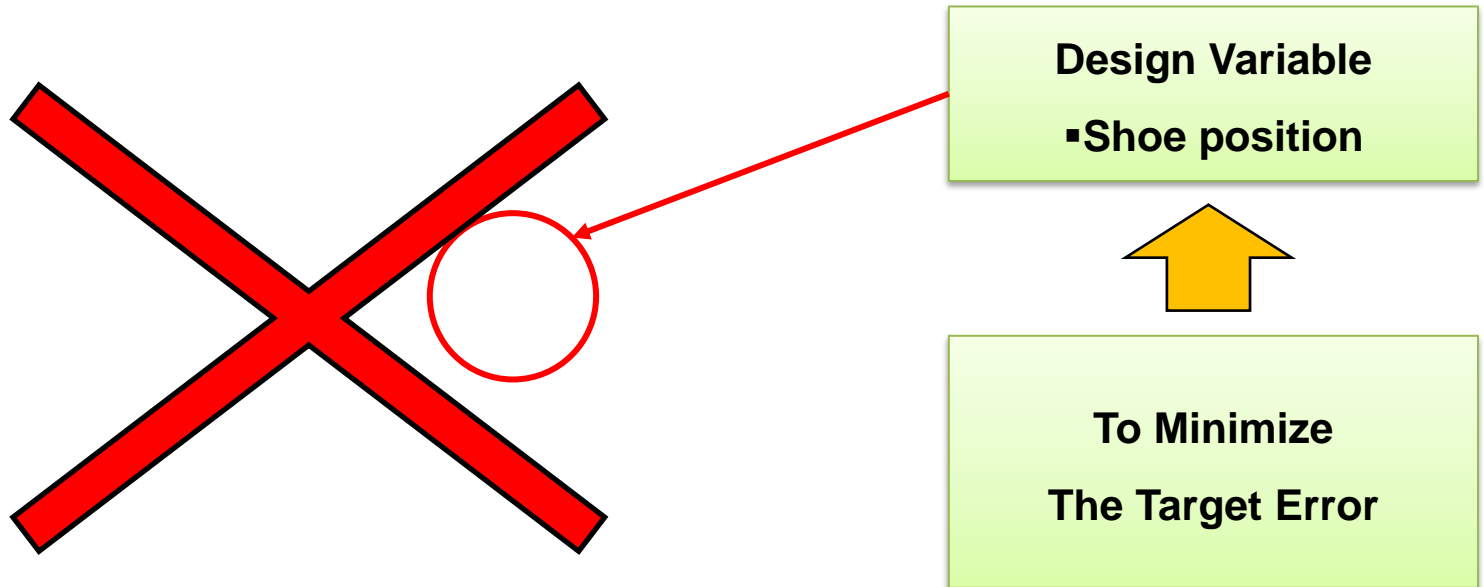


After Tuning



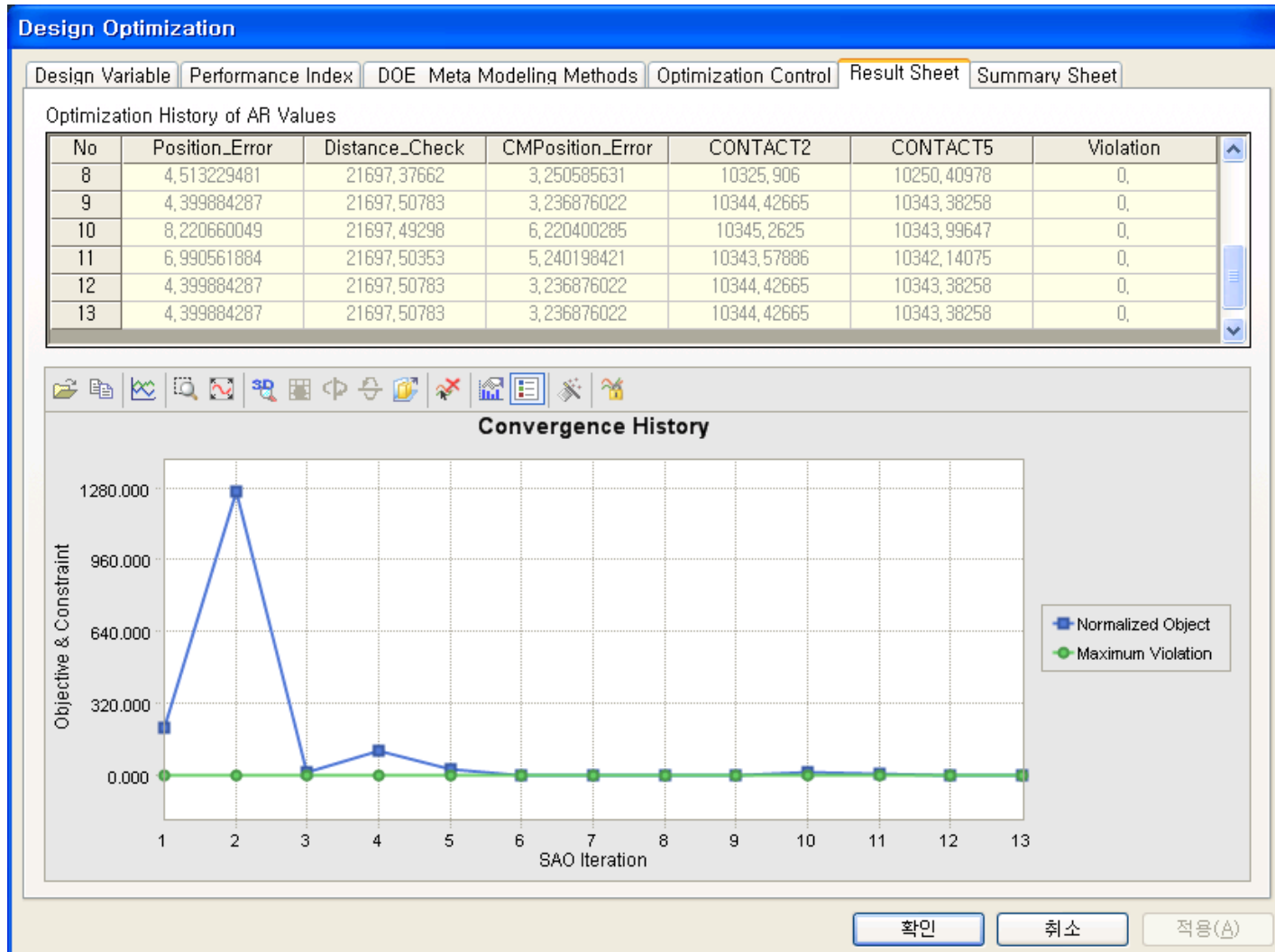
3.3 Deterministic Design Optimization

- **Deterministic Design Optimization (1/3)**
 - **Definition of Design Problem**



3.3 Deterministic Design Optimization

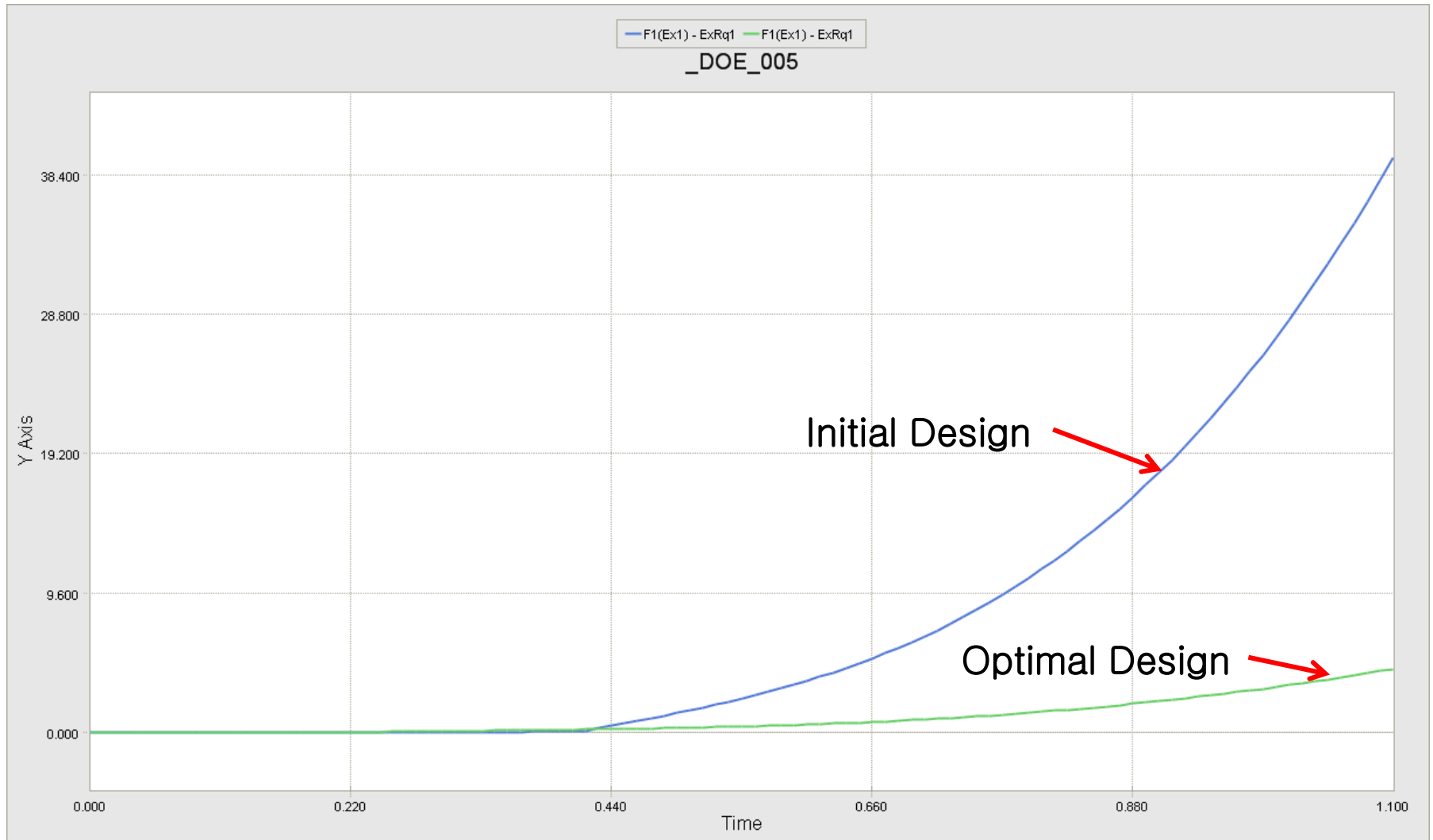
- Deterministic Design Optimization (2/3)
 - Convergence History



3.3 Deterministic Design Optimization (3/3)

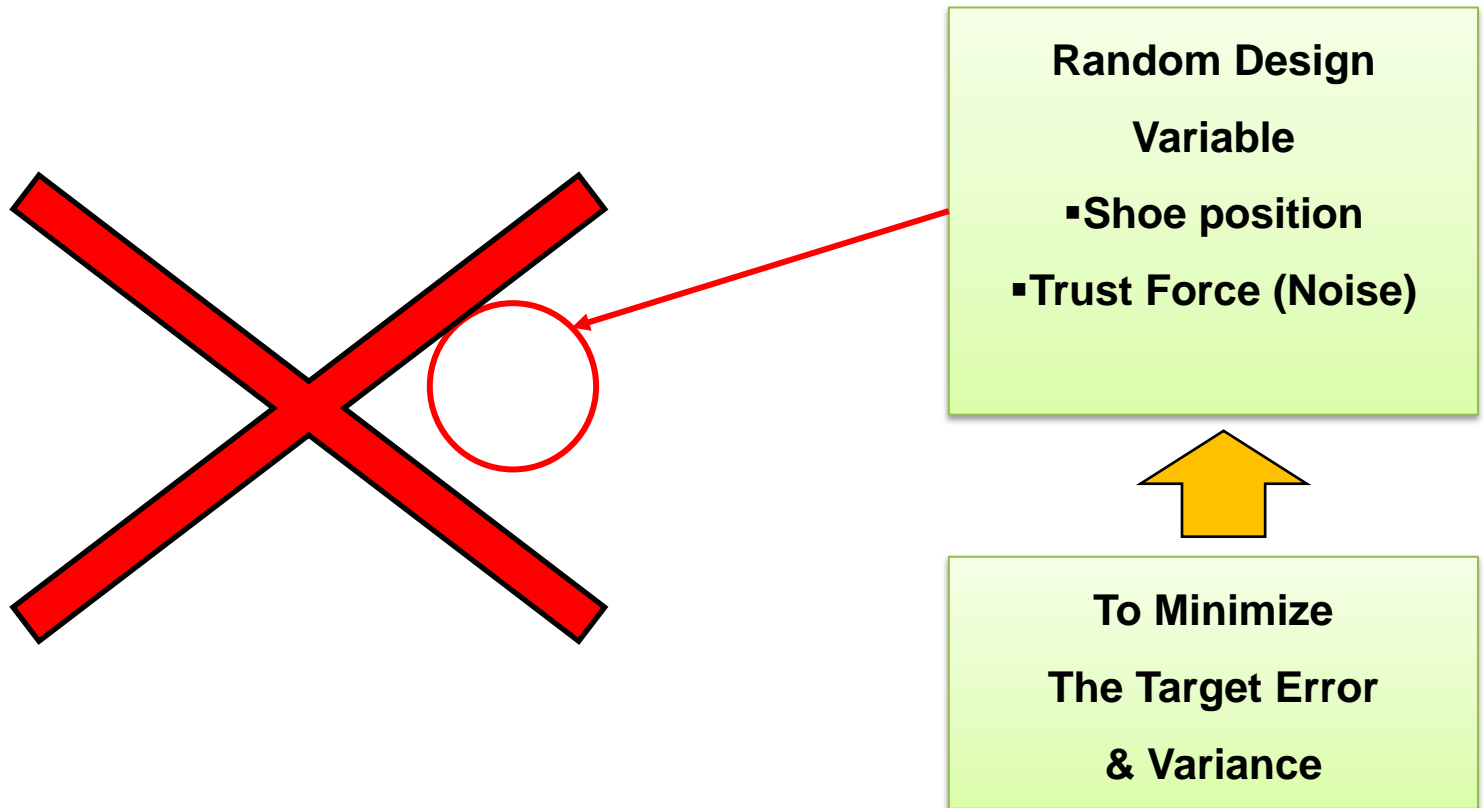
□ Deterministic Design Optimization (3/3)

- Results



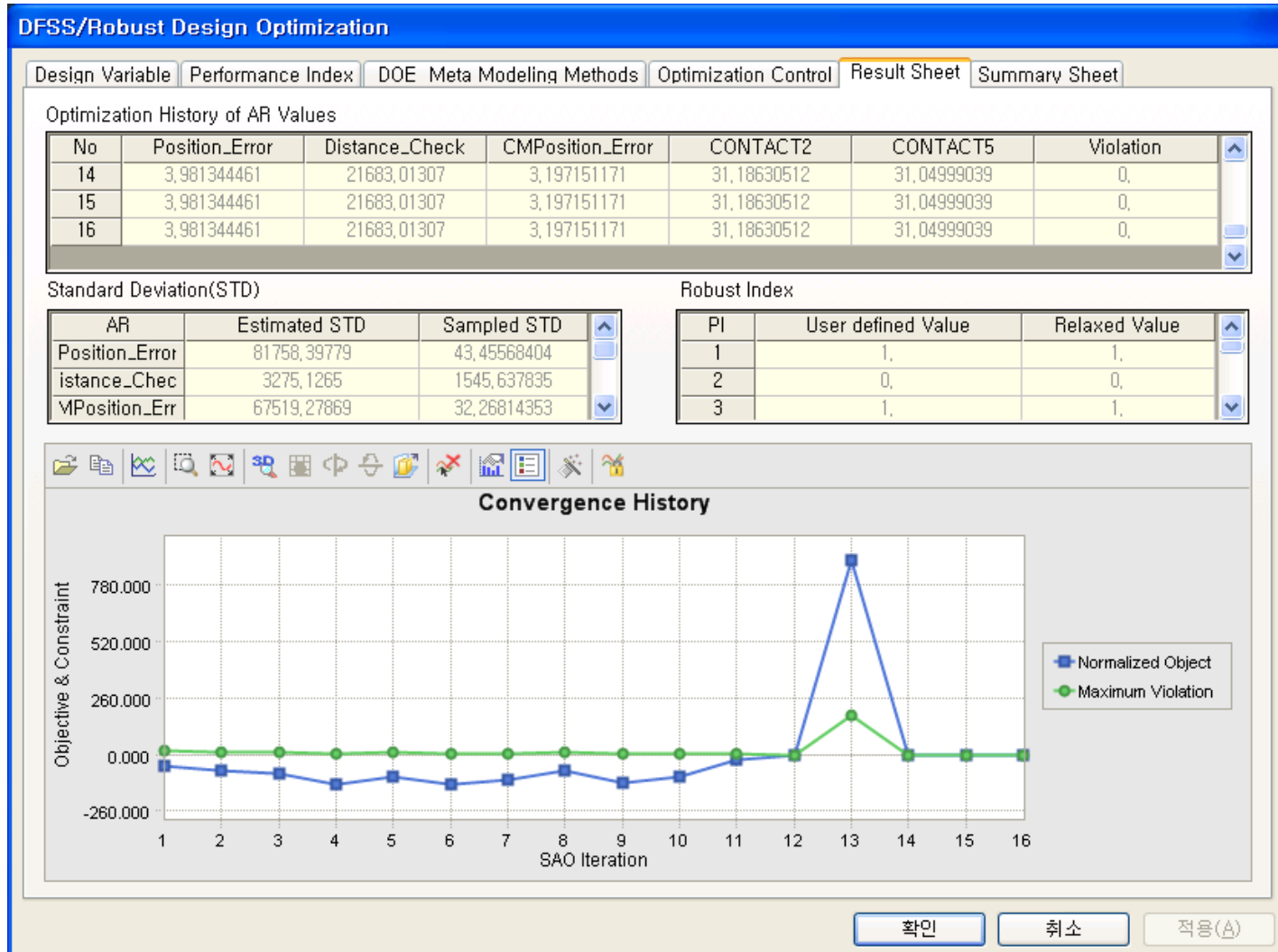
3.4 Robust Design Optimization

- Robust Design Optimization (1/3)
 - Definition of Design Problem



3.4 Robust Design Optimization

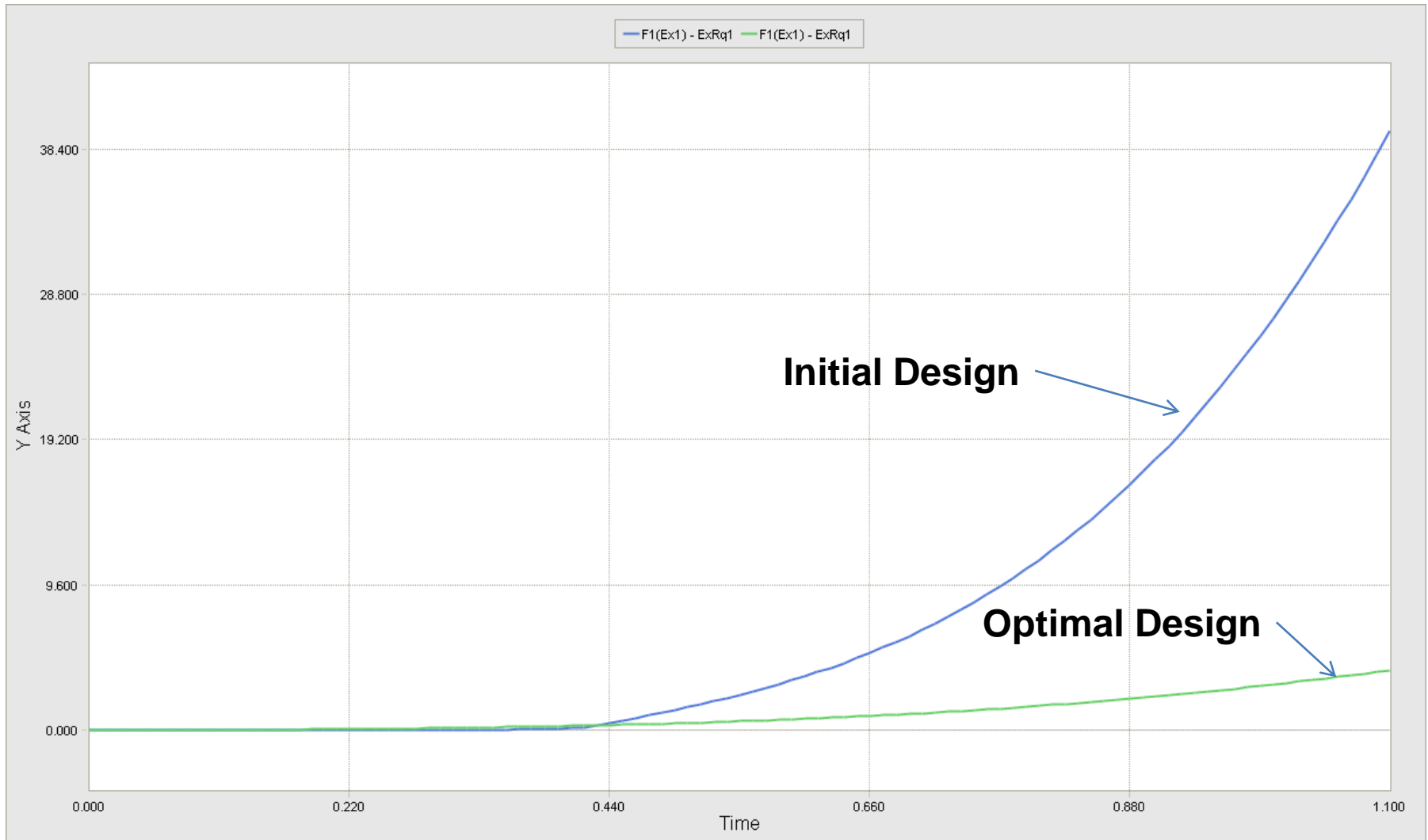
- Robust Design Optimization (2/3)
 - Convergence History



3.4 Robust Design Optimization

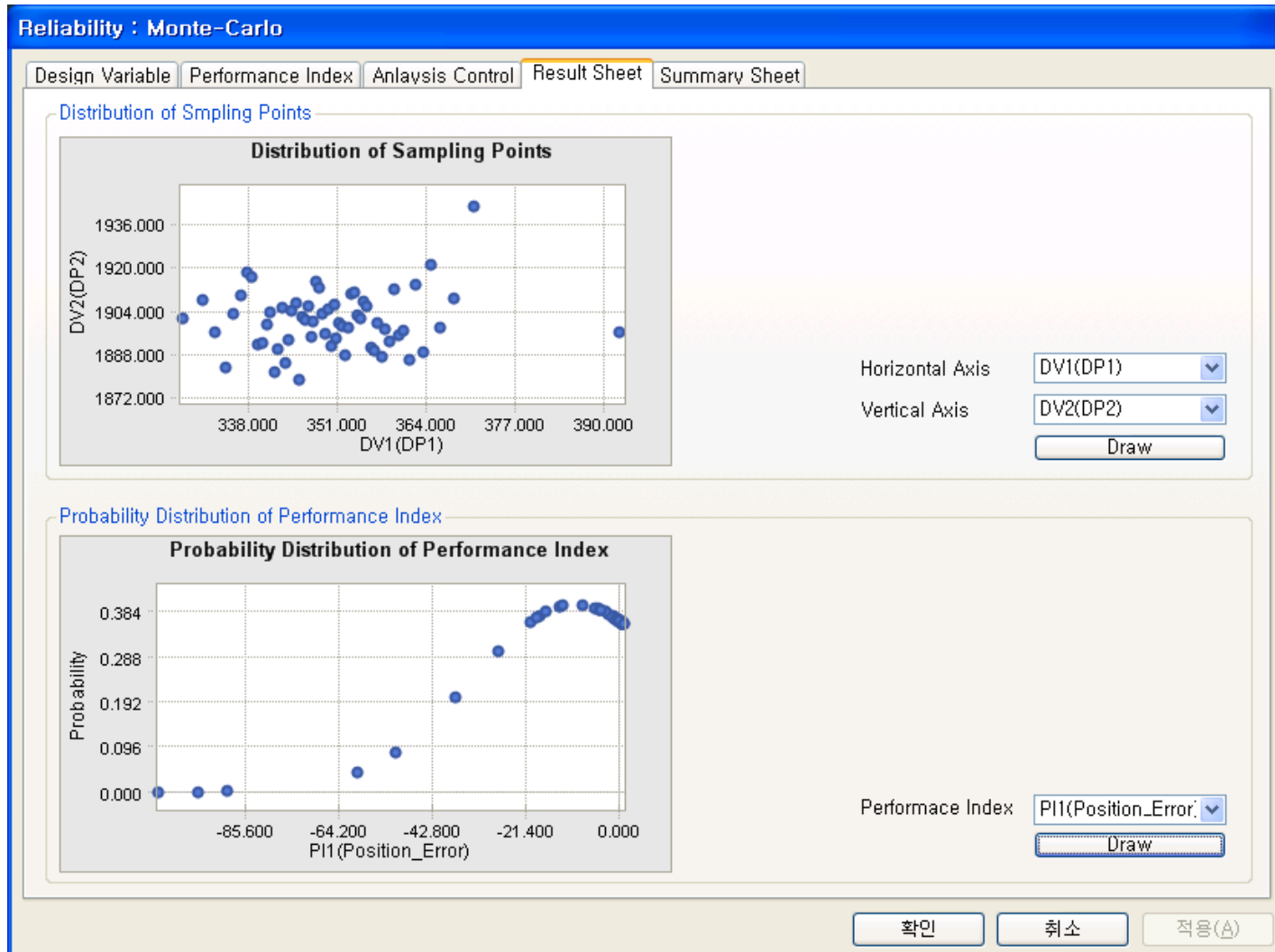
□ Robust Design Optimization (3/3)

- Results



3.5 Validation based on Reliability

- Case1: Deterministic Design Optimization Result 반영
 - Result (1/2)



3.5 Validation based on Reliability

- Case1: Deterministic Design Optimization Result 반영
 - Result (2/2)

Reliability : Monte-Carlo

Design Variable | Performance Index | Analysis Control | Result Sheet | Summary Sheet

Statistical Variables

No	Name	Description	Mean	Standard Dev.	Distribution	Param_1	Param_2	Param_3
1	DP1	ShoeBody1_2_Dis	349,704241	10,	Normal	0,	0,	0,
2	DP2	ShoeBody3_4_Dis	1900,068639	10,	Normal	0,	0,	0,
3	DP3	ShoeBody5_6_Dis	350,	10,	Normal	0,	0,	0,
4	DP4	Thrust_X_Scale	1,	0,1	Uniform	0,8267949192	1,173205081	0,
5	DP5	Thrust_Y_Scale	1,	0,1	Uniform	0,8267949192	1,173205081	0,

Performance Index (Formulation)

No	AR	Description	Definition	Goal	Limit Value	Probability of Failure
1	Position_Error	Position_Error	Constraint	LE	100,	0,5833333333
2	CMPosition_Error	CMPosition_Error	Constraint	LE	100,	0,5

Performance Index (Result)

No	Name	Description	Current Value	Mean	Standard Dev.	COV of Probability	Relative Norm
1	Position_Error	Position_Error	0,9559399788	-10,09182761	23,38674692	0,1091089451	11,55696784
2	CMPosition_Err	CMPosition_Err	0,9675276138	-8,146072604	20,08408875	0,1290934449	9,419472982

Summary of Analysis

Analysis Method: Monte-Carlo Simulation

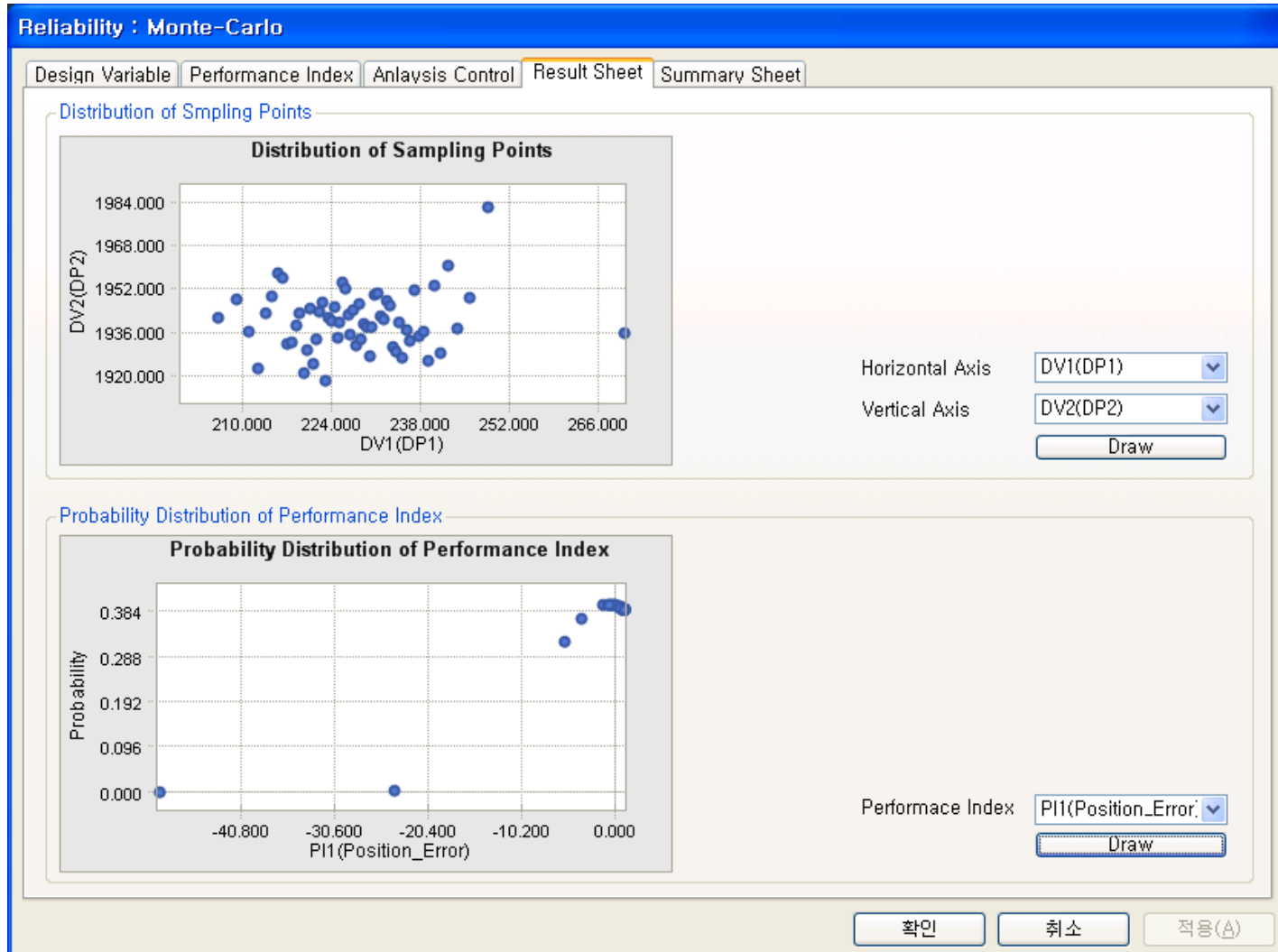
Number of Sampling Points: 60 Sampling Method: Discrete Latin HyperCube

Open Summary file

확인 취소 적용(△)

3.5 Validation based on Reliability

- Case2: Robust Design Optimization Result 반영
 - Result (1/2)



3.5 Validation based on Reliability

- Case2: Robust Design Optimization Result 반영
 - Result (2/2)

Reliability : Monte-Carlo

Design Variable | Performance Index | Analysis Control | Result Sheet | **Summary Sheet**

Statistical Variables

No	Name	Description	Mean	Standard Dev.	Distribution	Param_1	Param_2	Param_3
1	DP1	ShoeBody1_2_Dis	227,2851118	10,	Normal	0,	0,	0,
2	DP2	ShoeBody3_4_Dis	1939,630263	10,	Normal	0,	0,	0,
3	DP3	ShoeBody5_6_Dis	290,399786	10,	Normal	0,	0,	0,
4	DP4	Thrust_X_Scale	1,	0,1	Uniform	0,8267949192	1,173205081	0,
5	DP5	Thrust_Y_Scale	1,	0,1	Uniform	0,8267949192	1,173205081	0,

Performance Index (Formulation)

No	AR	Description	Definition	Goal	Limit Value	Probability of Failure
1	Position_Error	Position_Error	Constraint	LE	100,	0,2
2	CMPosition_Error	CMPosition_Error	Constraint	LE	100,	0,15

Performance Index (Result)

No	Name	Description	Current Value	Mean	Standard Dev.	COV of Probability	Relative Norm
1	Position_Error	Position_Error	0,9601865554	0,792928772	7,180187122	0,2581988897	1,825806994
2	CMPosition_Errc	CMPosition_Errc	0,9680284883	0,306420672	5,365545457	0,3073181486	1,316540966

Summary of Analysis

Analysis Method: Monte-Carlo Simulation

Number of Sampling Points: 60 Sampling Method: Discrete Latin HyperCube

Open Summary file