

Tailor-Made Optimization Using Multi-Sigma®

1. Fundamental principles of tailor-made optimization with Multi-Sigma®

When conducting optimization, focusing solely on driving **Concept of standard optimization** the output variables toward their desired values can lead Output Input to unrealistic input-variable settings. Desired value: Values of input Desired Optimization Maximization variables required Ex 1: Medical field output result to achieve the Minimization Target value desired output Need to Minimize the Patient Neural network Al Model reduce age probability of Multi-objective genetic algorithm data by 15 years disease onset **Execute optimization** User-specified Ex 2: Livestock industry Concept of tailor-made optimization Need to Maximize the

Ex 3: Manufacturing field Component data

Livestock

data

∖l Model

Al Model

Maximize component strength

growth rate of

livestock

Exceed specified input range

reduce

height

Desired value: Maximization Minimization

Output

Target value

User-specified

Values of input variables required to achieve the desired output

Input

Neural network Specified by the user Multi-objective genetic algorithm according to the Execute according to tailor-made conditions customized setup

To address this issue, Multi-Sigma® provides a tailor-made optimization feature. This feature allows users to impose constraints on the possible ranges of input values during optimization, enabling them to specify input parameters that fall within certain values or defined limits.

2. Case study of tailor-made optimization using Multi-Sigma® (Medical data)

Age	Height	Weight	Gender	Medication therapy	Physical therapy	Exercise therapy	Pain reduction	Training data Al Model Optimization
66	172	80	0	2	7	0	1.9	To execute optimization, it is first
76	168	88	0	7	6	10	4.2	necessary to build an Al model. In Multi-Sigma®, users can choose between a neural network and aussian process regression when constructing the Al model. Using the model built in this way, optimization is carried out to maximize the degree of pain reduction through therapy. However, since input variables such as age, height, weight, and gender need to be
84	167	54	1	7	6	10	4.5	
79	168	86	1	7	3	0	2.3	
84	150	56	0	8	4	4	0.1	
65	180	75	0	5	1	6	0.7	
85	157	57	0	7	0	9	3.5	
66	152	84	0	10	6	4	4.3	
88	180	83	0	6	3	1	3.4	
	Input							specified for each patient, the tailor-made optimization feature is used.

Medication Physical Exercise Height Weight Gender therapy 66 172

Fixed input variables:

Set to the values specific to the target patient.

therapy therapy

Adjustable input variables: Search for optimal values

reduction

Maximize

By fixing patient-specific input variables such as age, it becomes possible to propose a tailor-made treatment plan optimized for the individual patient.

Note 1) The data used in this analysis is an artificial dataset.

Note 2) For gender, 0 indicates male and 1 indicates female

Note 3) Pharmacotherapy represents the drug intensity (0 to 10).

Note 4) Physical therapy represents the frequency of therapy sessions (times per week). Note 5) Exercise therapy represents the intensity of the exercise program (0 to 10).

AIZOTH inc. provides a range of AI services, including Multi-Sigma®, AI consulting, experimental condition optimization support, and contract research and development.

Multi-Sigma® is a cloud-based Al software designed for research and development, significantly reducing experimental workload and enabling researchers to discover innovative solutions to realworld challenges with minimal experimental datasets.

https://aizoth.com/en/service/multi-sigma/ info@aizoth.com

