CS-OPT OPTIMIZATION REPORT

This report summarizes the canonical form of the investigated optimization problem and its results.

$$
\begin{aligned}
\min_{x} \quad & \text{Specific Absorpion Eenrgy} \rightarrow \boldsymbol{f(x)} \\
\text{s.t.} \quad & \text{Total Vehicle mass} \rightarrow \boldsymbol{g_1(x)} \leq 0, \\
& \text{intrusion: 5266147 in [mm]} \rightarrow \boldsymbol{g_2(x)} \leq 0, \\
& \text{intrusion: 5266147 in [mm]} \rightarrow \boldsymbol{g_3(x)} \leq 0, \\
& \text{intrusion: 5266147 in [mm]} \rightarrow \boldsymbol{g_4(x)} \geq -2.7, \\
& \text{intrusion: 5266147 in [mm]} \rightarrow \boldsymbol{g_9(x)} \leq 0, \\
& \text{intrusion: 5266147 in [mm]} \rightarrow \boldsymbol{g_{10}(x)} \geq 3.0, \\
& t_{BU} \in C_{t_{BU}} = [0.0 - 5.0], \\
& x_1 \in C_1 = [0.0 - 5.0], \\
& x_1 \in C_1 = [0.0 - 5.0], \\
& x_1 \in C_1 = [0.0 - 5.0], \\
& x_1 \in C_1 = [0.0 - 5.0], \\
& x_2 \in D_2 = [1000, 2000, 3000, 1000, 2000, 3000], \\
& x_2 \in D_2 = [1000, 2000, 3000], \\
& x_2 \in D_2 = [1000, 2000, 3000], \\
& x_2 \in D_2 = [1000, 2000, 3000], \\
& x_2 \in D_2 = [1000, 2000, 3000]
\end{aligned}
$$

The following optimizations settings have been used to run the optimization.

epsilon:	1.2345	**encoding:**	1.2345
parallel jobs:	1743547	**use SCIP:**	-320.75
CV:	732946	**stop if feasible:**	-320.75
max time SCIP:	57.96	**SCIP gap:**	-320.75
max time Grad:	-1049.87	**modify constraints:**	-320.75
CV error metric:	-887.68	**modify constraints:**	-320.75
Metamodels:	-320.75	**modification value:**	-320.75
Scale response:	-1049.87	**use Localsearch:**	-320.75

The convergence trend is shown in the figure below. The red points represent the designs where

one or more constraints have been violated. Green ones represent designs that satisfy all constraints functions. The yellow marker identifies the optimal solution.

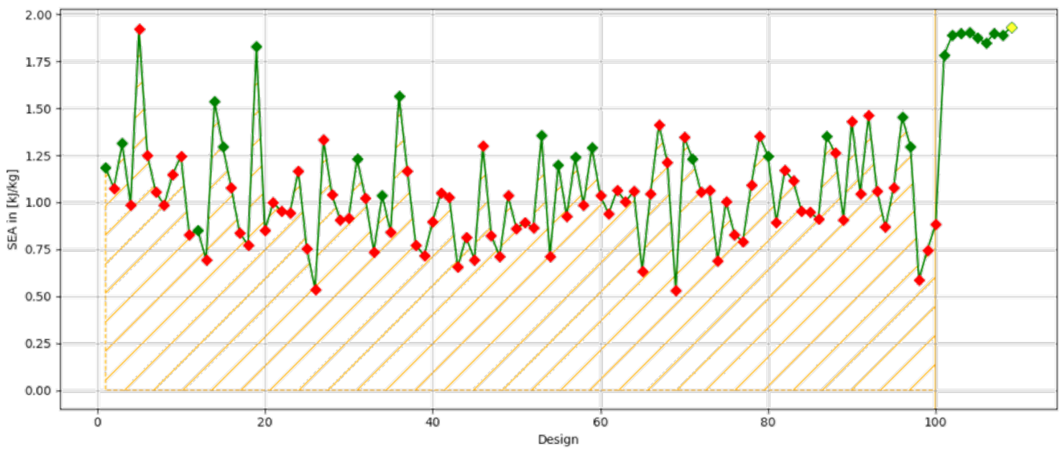

Figure 1: Convergence History Curve

Every iteration steps is summarized in the table below.

Table 1: Table of Results

	x1	**x2**	**x3**	**x4**	**x5**	**x6**	**x7**	**x8**	**x9**	**x10**	**x11**	**f(x)**	**g(x)**
0001	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0002	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0003	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0004	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0005	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0006	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0007	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0008	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0009	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0010	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0011	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0012	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0013	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0001	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0001	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
0001	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
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0001	1.570	3.180	1.890	1.110	1.510	1.540	1.070	3000	1000	20000000	3000	0.234	24.23
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The initial design was improved about 13% while fullfilling all the chosen constraints.

	Initial Design	Best Design
f(x)	0.05	1.23
g(x)	983.05029	183.15137
x1	746	123
x2	746	123
x3	746	123
x4	746	123
x5	746	123
x6	746	123
x7	746	123
x8	746	123
x9	746	123
x10	746	123
x11	746	123

Table 2: Comparison of the starting Design and the optimized Design

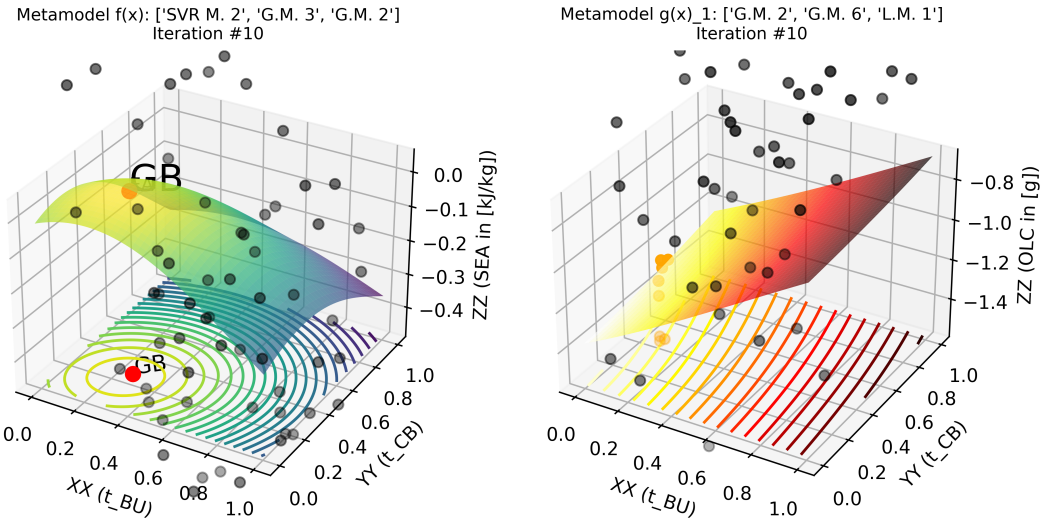

Figure 2: Metamodels of the Optimal Design