

MULTI OBJECTIVE OPTIMIZATION OF START STOP SYSTEM SOLENOID

SAKTHIVADIVEL D

Robert Bosch Engineering and Business
Solutions Limited (RBEI)



BOSCH

MOO - START/STOP SOLENOID

START STOP SYSTEM

The best solution –
for customers and the
environment

Bosch engineers are continuously working on innovative system solutions. The success of these developments speaks for itself: for decades Bosch has been one of the world's leading companies in the field of patented inventions.

Starter motors

Our extensive range comprises innovative, sturdy starter motors for all passenger cars with gasoline and diesel engines. In addition to high starting reliability, Bosch starter motors, with their compact, light construction, allow simple application for vehicle manufacturers. As well as conventional starter motors, we offer a broad range of tried-and-proven Start/Stop Starter Motors for economical and comfortable start/stop solutions in vehicles.

Generators

Bosch offers a broad range of compact, quiet-running generators for a wide variety of requirements and all types of passenger car. They feature high performance and efficiency. Our generators thus allow a reliable supply of energy to every vehicle electrical system and contribute towards an appreciable reduction in fuel consumption and CO₂ output.

Solutions for commercial vehicles

Our product range for commercial vehicles comprises sturdy, powerful starter motors and efficient generators. High quality products with a service life of some 800,000 km, suitable for demanding applications and the toughest working conditions in on- and off-highway operation.

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Starter Motors and Generators

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Starter Motors and Generators
**Start/Stop technology reduces
CO₂ emissions and saves fuel**



BOSCH
Invented for life

clean &
economical



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START STOP SYSTEM

2 | Start/Stop Starter Motors

Start/Stop Starter Motors:
**Drive normally –
save as never before**



The advantages of the system are particularly evident in city traffic.



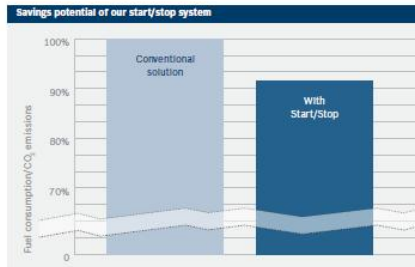
No movement – zero consumption: a principle which saves money. Innovatively implemented and technically realized by Bosch.

Start/Stop Starter Motors | 3

Reduce CO₂, save fuel and costs – automatically and without changing your usual driving style? Bosch makes it possible. With a technically mature, very effective and at the same time cost-favorable solution: the Start/Stop Starter Motor for use in start/stop systems. Suitable for vehicles with manual or automatic transmission, particularly efficient in the "stop-and-go" conditions of dense urban traffic.

Economical driving and clean stops

The operating principle of the start/stop system is as simple as it is efficient: when the vehicle comes to a stop, the engine is automatically switched off. To drive off again, all you need to do is to activate the clutch or, in the case of vehicles with automatic transmission, take your foot off the brake pedal to restart the engine. A warm start only consumes as much fuel as 0.7 seconds idling time. So each stop saves money and benefits the environment from the first second on.



Our system saves money and preserves the environment

Vehicle with manual transmission



When the vehicle comes to a stop the engine is immediately switched off when the gear lever is in neutral and the clutch pedal is released.



Activating the clutch pedal once again restarts the engine automatically.

Vehicle with automatic transmission



After the brake pedal has been depressed, the engine is switched off as soon as the vehicle comes to a stop.



When the brake pedal is released, the engine restarts – rapidly and reliably.

An investment that quickly pays for itself

The relatively low extra cost for acquiring such a system is more than outweighed by its enormous savings potential: in the ECE15 measuring cycle, the urban section of the New European Driving Cycle (NEDC), reductions in fuel consumption and emissions of around 8% were measured. This cycle comprises a trip of 7 km with 12 stops of 15 seconds each. In actual urban traffic, stopping times can be considerably longer and savings – both in terms of fuel consumption and CO₂ output – can be as much as 15%. The employment of our system is thus a cost-saving and extremely effective way of adhering to both present and future emission limits.

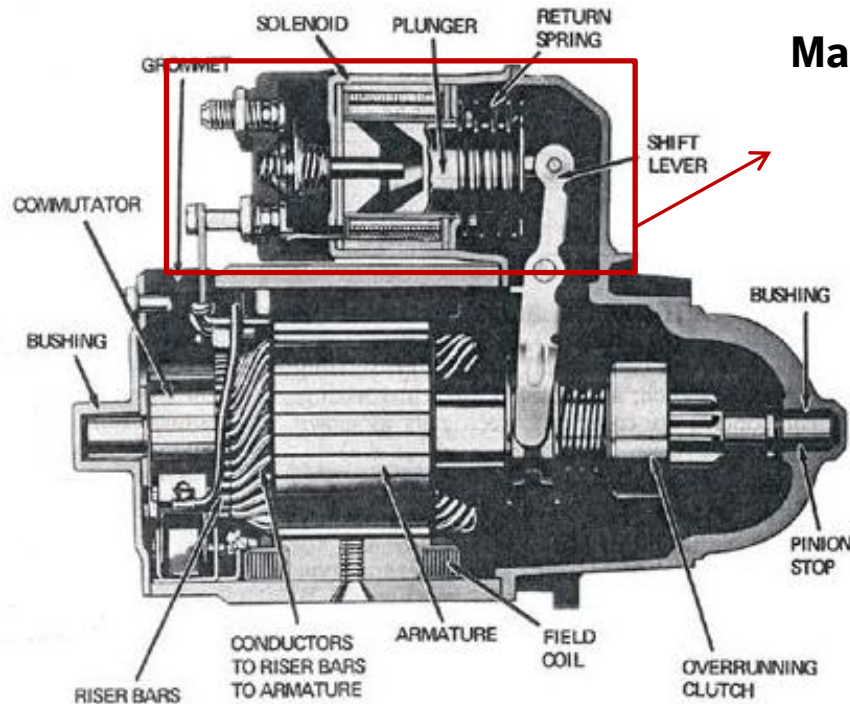
Simple operation of the start/stop function



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NORMAL STARTER'S SOLENOID

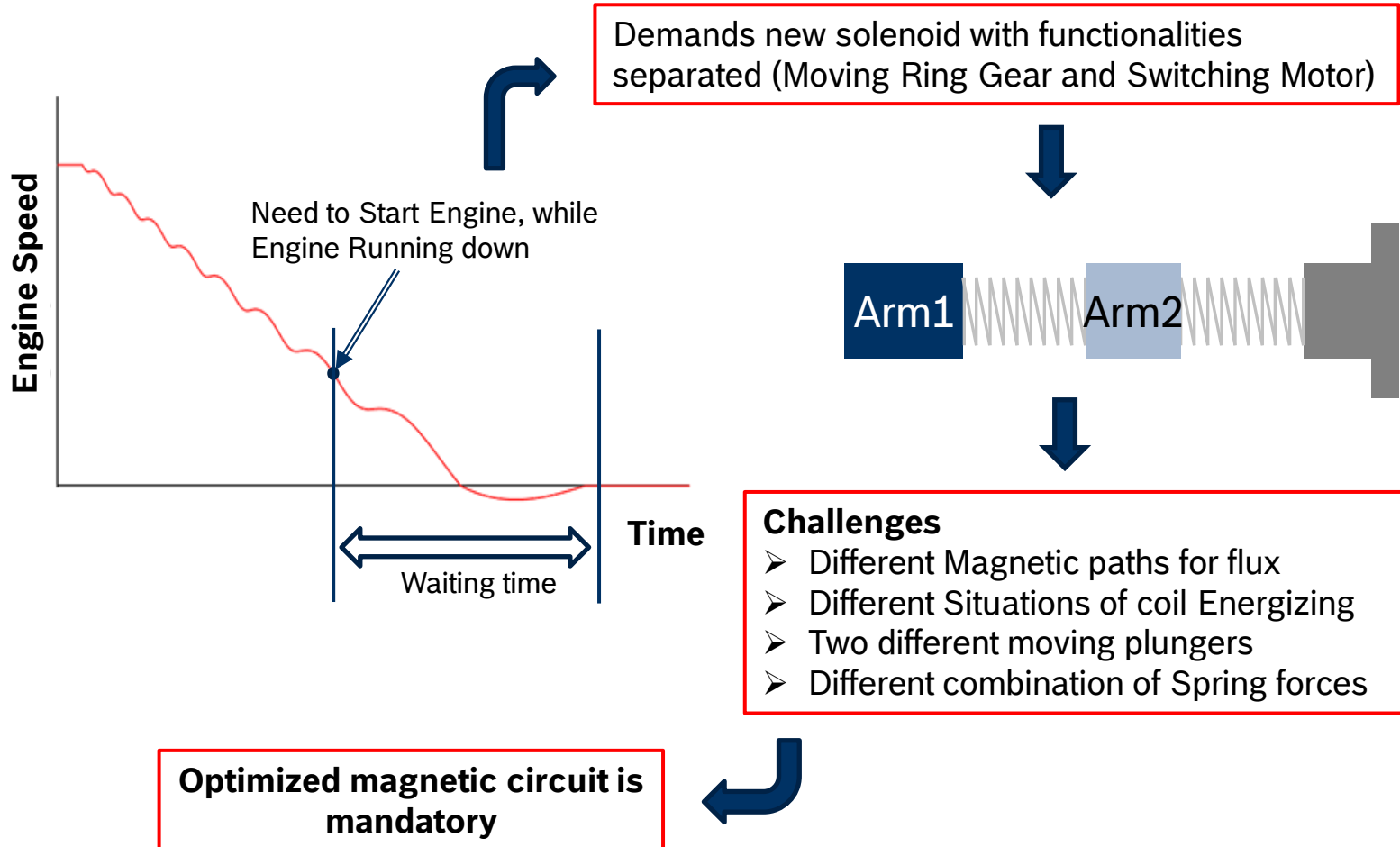


Main Functions of Solenoid is for,

1. Moving pinion towards ring gear
2. Switch to supply power to the motor

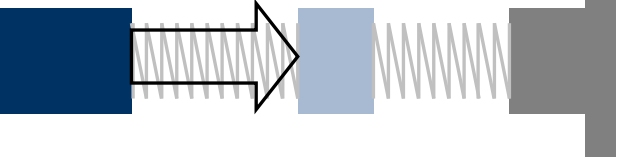
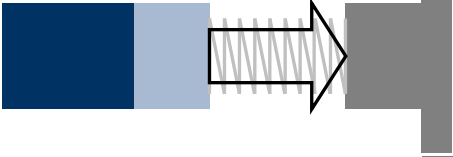
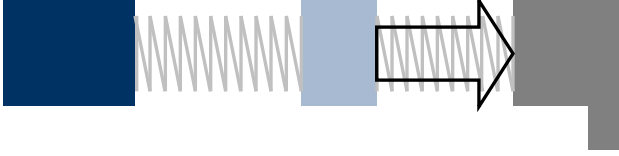
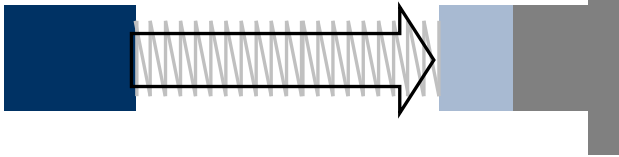
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CHANGE OF MIND FUNCTION



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DIFFERENT USE CASES

Armature 1 alone moves Coil 1 excited Armature 2 Stays at place	UC1	
Armature 1 & Armature 2 moves together Both Coils excited Armature 1 Stays on Armature 2	UC2	
Armature 1 Stays at place Coil 2 excited Armature 2 Stays at place	UC3	
Armature 2 already moved Both Coils excited Armature 1 alone moves	UC4	

Arm1

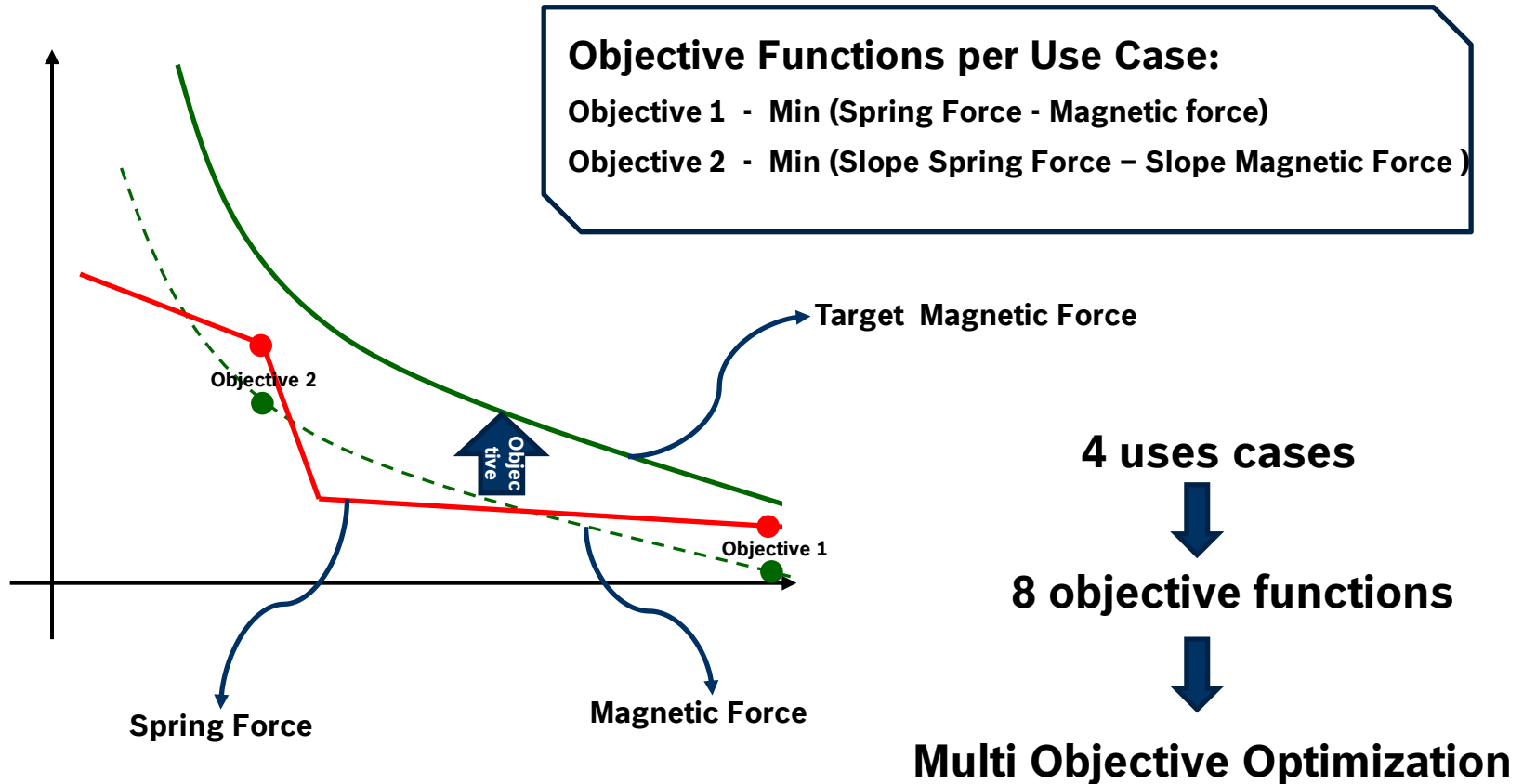
Arm2



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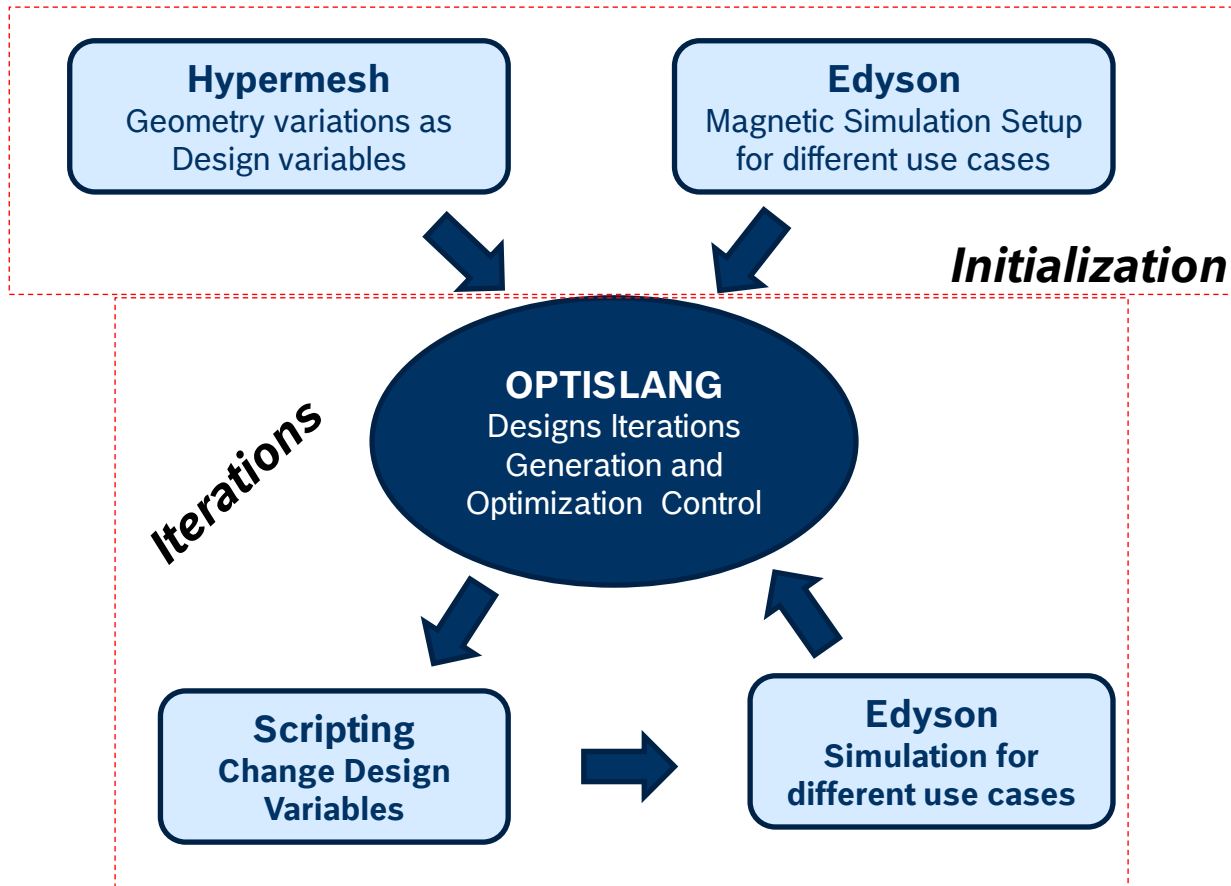
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OBJECTIVE FOR OPTIMIZATION



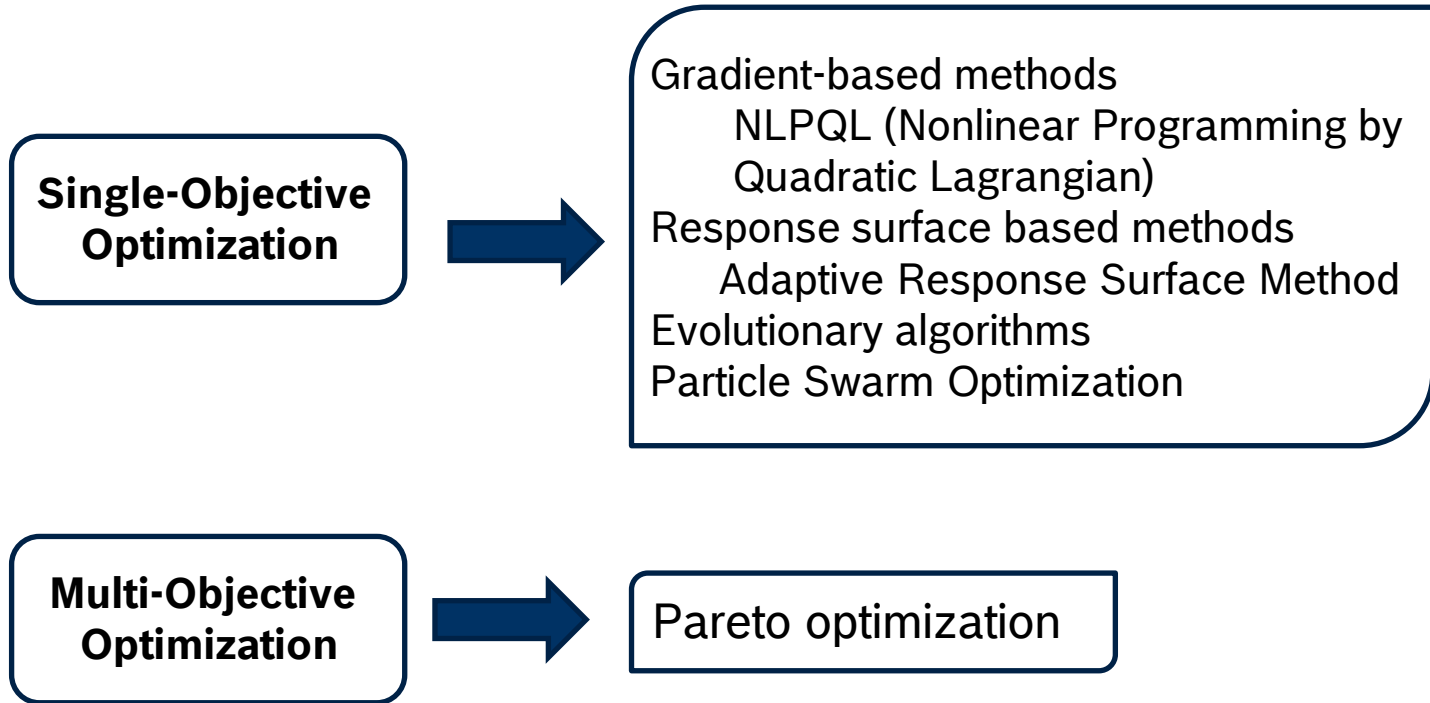
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TOOL CHAIN – FLOW CHART

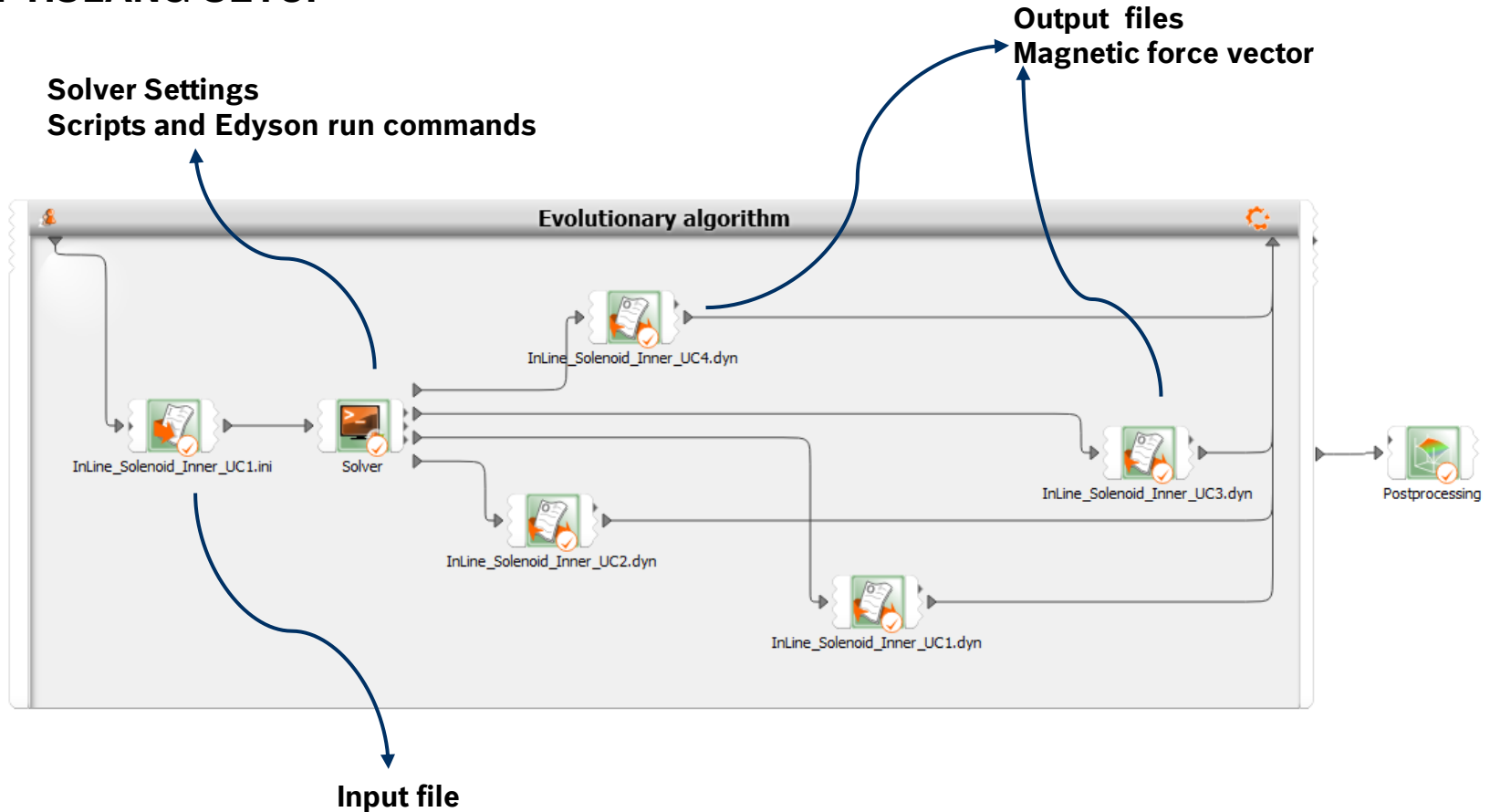


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SINGLE AND MULTI OBJECTIVE OPTIMIZATIONS

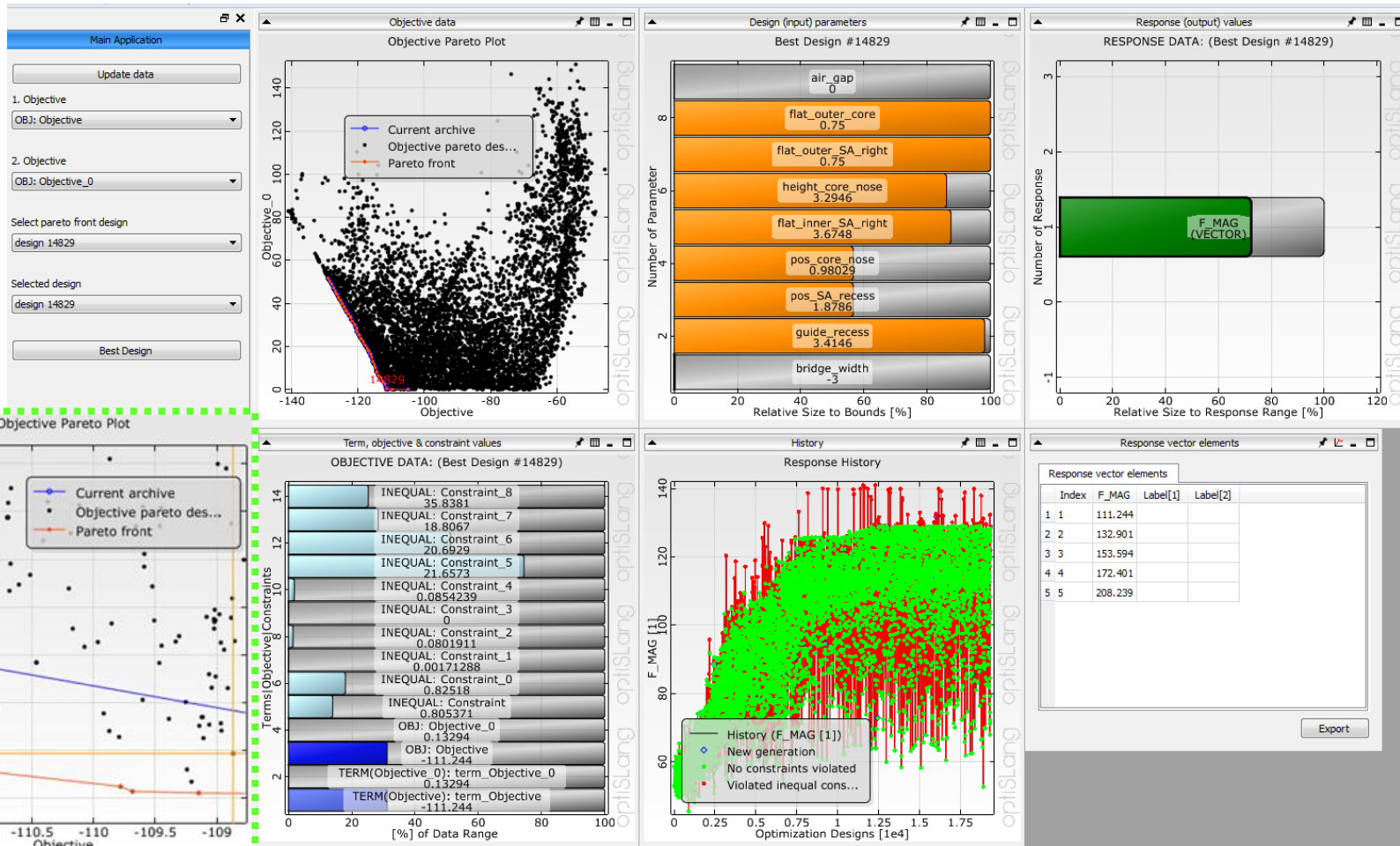


OPTISLANG SETUP



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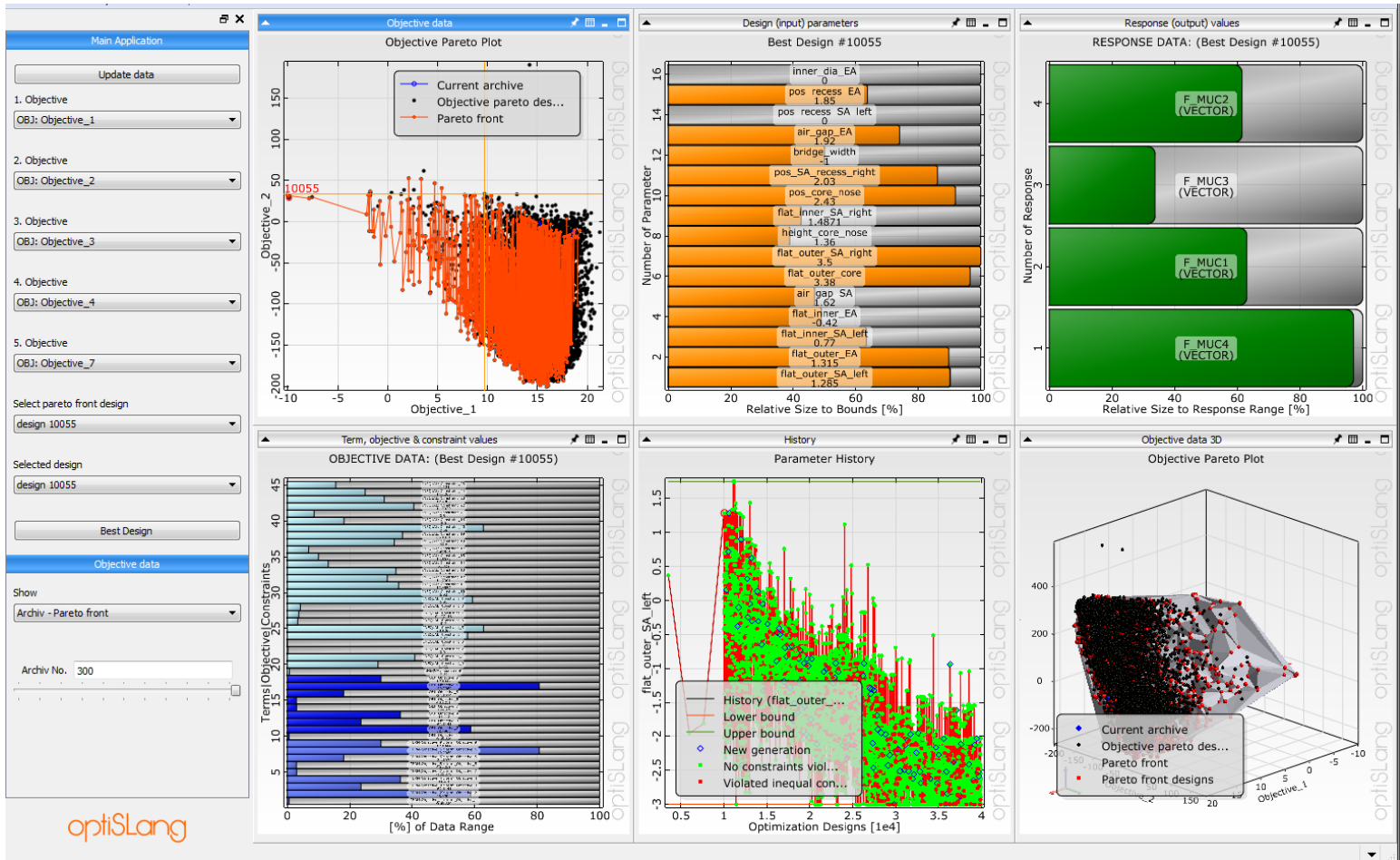
RESULTS AND POST PROCESSING



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POST PROCESSING CHALLENGES

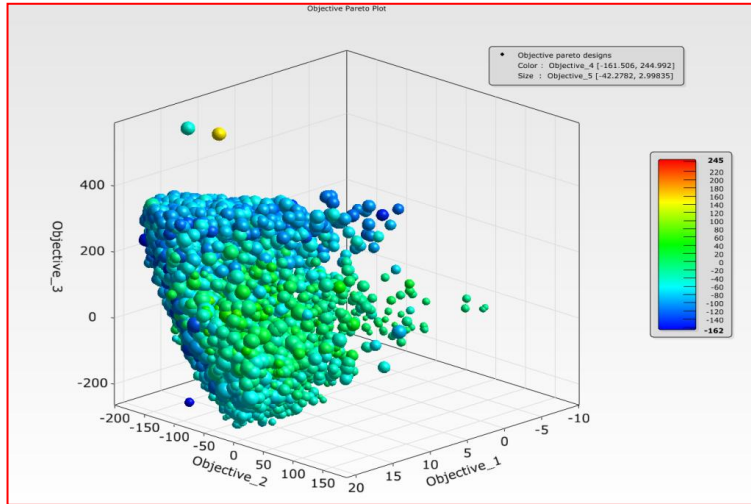


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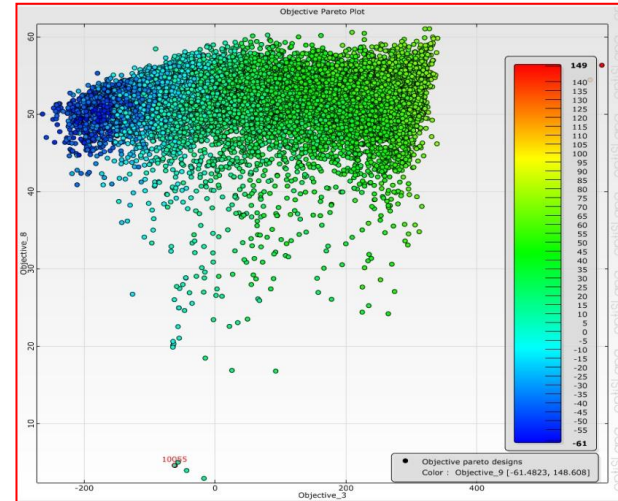
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POST PROCESSING OPTIONS

5 Dimensional Plot



3 Dimensional Plot







Exporting to Excel



Design table

File View



Design Overview

Parameters

Responses

Constraints

Objective Functions

#	Details			Tag Information				
	Nr.	Identical Design	Failure Code	Pareto front design	Constraints fulfilled	flat_outer_SA_left	flat_outer_EA	flat_inner_S
1	3526			<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.3697471432	0.7472446107	-1.922971926
2	5968			<input type="checkbox"/>	<input checked="" type="checkbox"/>	-1.952389961	1.488215567	-1.651277147
3	7631			<input type="checkbox"/>	<input checked="" type="checkbox"/>	-1.812754589	0.001038473798	-2.909423729
4	9993			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1.285	1.315	0.77



Function @ u.c.								
	u.c.1	u.c.2	u.c.3	u.c.4	u.c.5	u.c.6	u.c.7	u.c.8
Objective 1	42.7	101.7	147.9	170.0	279.5	47.4	115.3	33.5
Objective 2	42.5	100.2	147.8	168.8	290.3	45.6	116.7	32.9
Objective 3	42.6	102.0	147.8	169.7	278.6	47.6	115.0	33.6
Objective 4	42.6	101.9	147.6	169.9	280.5	46.9	115.9	33.4
Objective 5	38.6	105.4	147.3	165.8	305.0	42.1	118.4	31.5
Objective 6	51.1	103.9	147.2	164.3	283.5	50.4	101.7	34.7
Objective 7	51.1	102.2	147.0	161.9	295.0	48.6	102.5	34.0
Objective 8	41.5	106.4	145.7	167.4	281.7	47.4	116.7	33.6
Objective 9	51.3	101.8	145.6	159.8	282.8	47.7	100.6	33.7
Objective 10	40.5	103.7	145.3	167.9	261.6	47.4	114.1	33.5
Objective 11	40.5	103.7	145.3	167.9	261.6	47.4	114.1	33.5
Objective 12	42.6	102.0	145.2	165.4	261.7	45.9	112.1	33.0
Objective 13	38.9	112.4	145.0	164.9	282.1	46.2	112.4	33.7



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OPTISLANG 😊

Preprocessing

- Simple UI (Drop down Template, Modules)
- Easy Integration of Scripting, i/p and o/p files
- Inclusion of start designs and etc

Solving

- More Parallel solvers possible
- Useful Scripting (more number of simulations (ex. Use cases) per design iteration)
- Design directories are well organized and etc

Post processing

- 3 or 4 dimensional plots
- Viewing response vectors values, Objectives and Constraints simultaneously
- Exporting design to Excel sheets and etc

OPTISLANG 😞

Overall

- *UI* Stability
- Restarting MOO capabilities
- Post Processing tool limitation design number and objective combined

