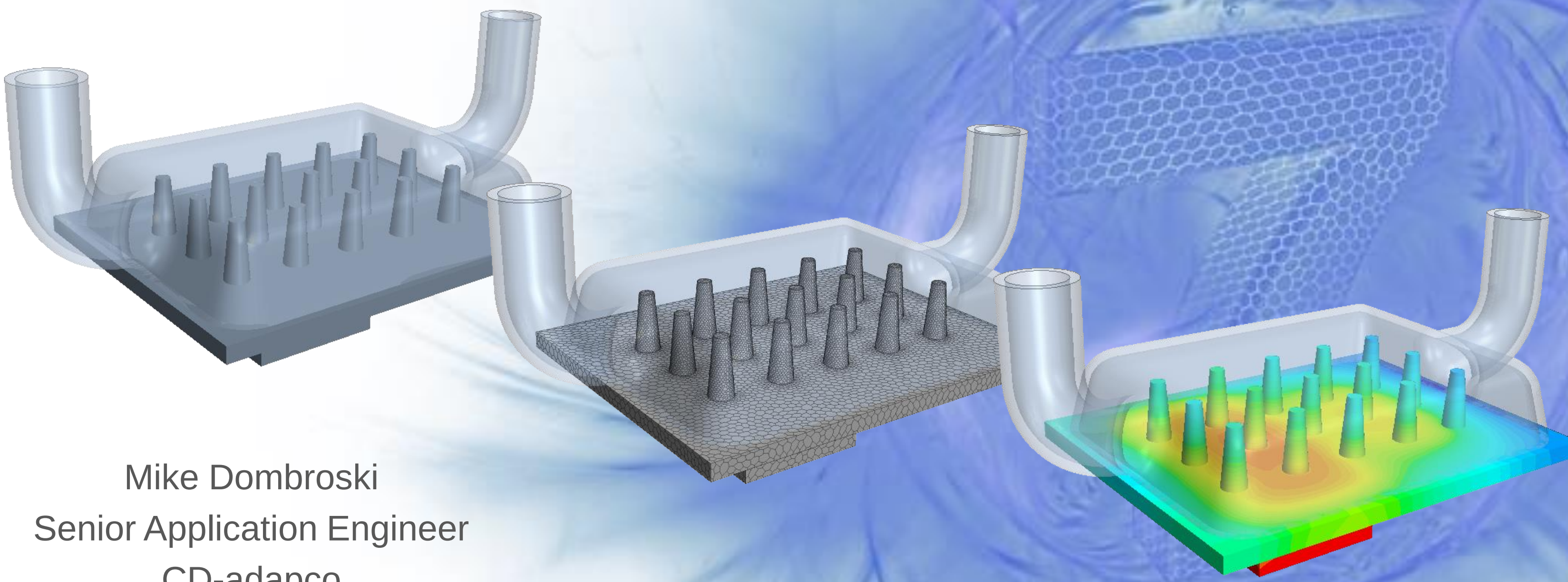
OPTIMIZE THIS! 2012

Electronic Cooling Optimization

Comparing Search Methods

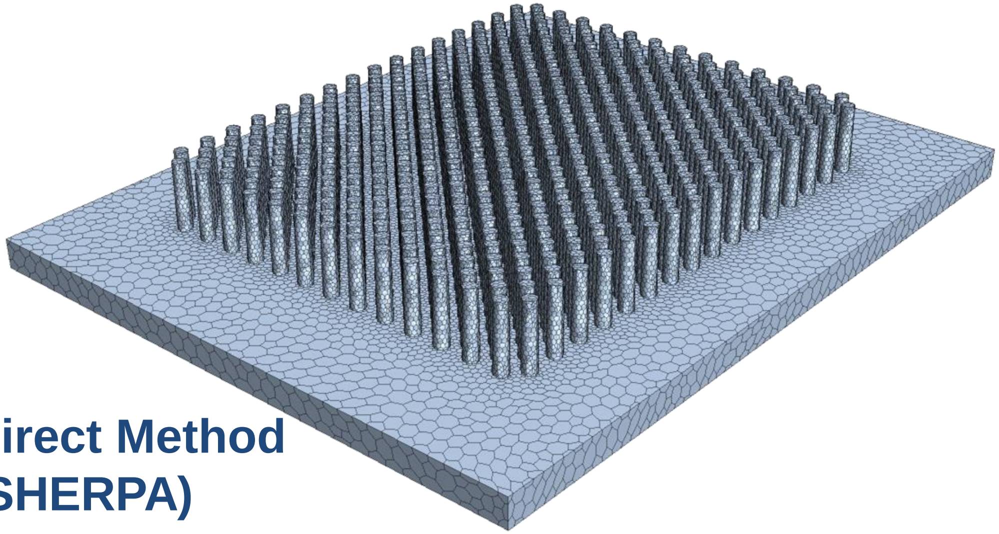


STAR-CCM+ v7

Mike Dombroski
Senior Application Engineer
CD-adapco
October 2012

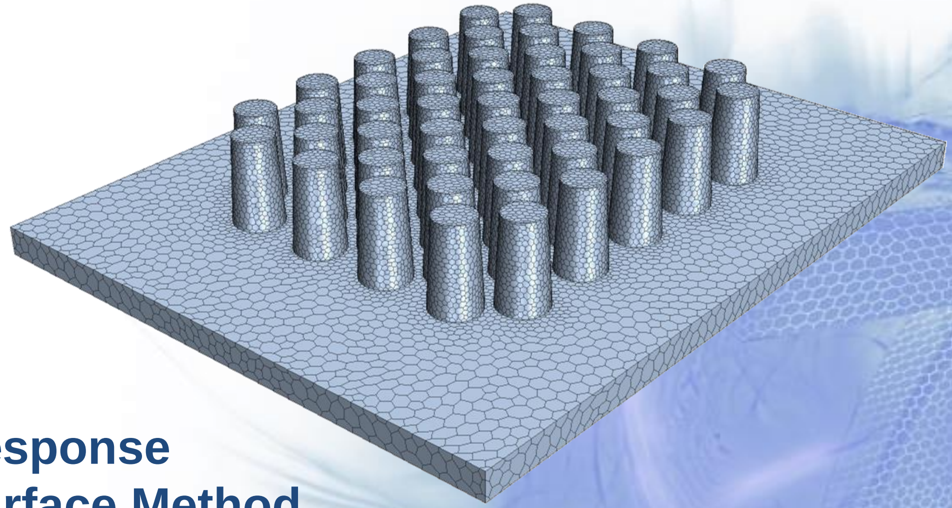
CD-adapco

Results – Best Designs

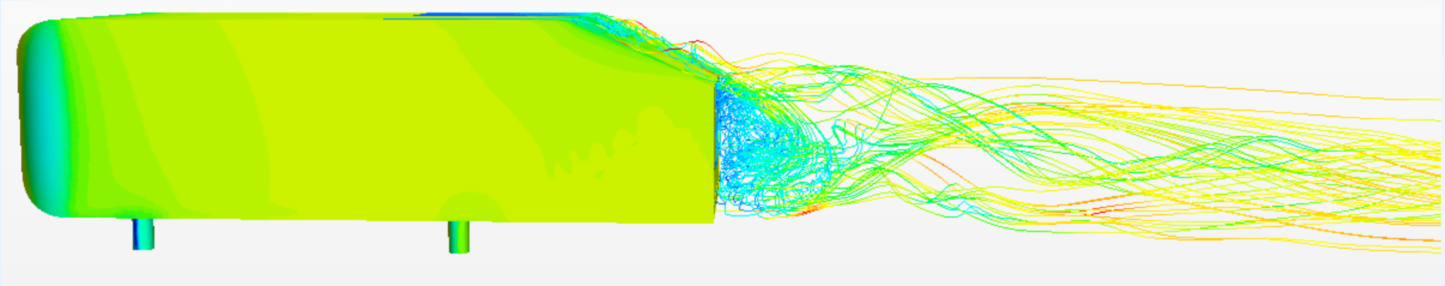


Direct Method (SHERPA)

SHERPA found 4x as many feasible designs and best solution is 10% better than that found with RSM



Response Surface Method

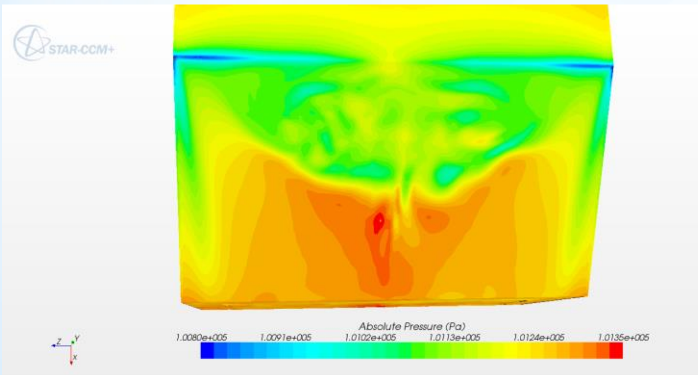


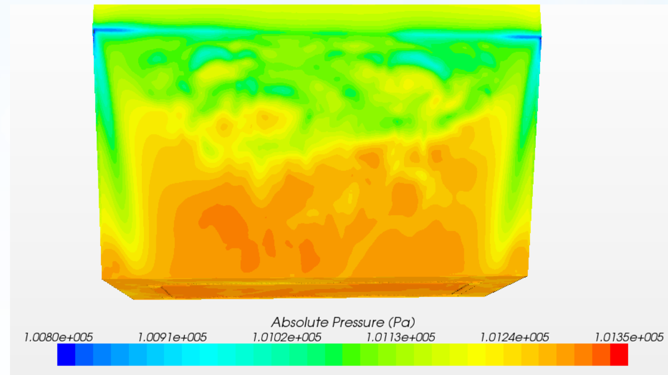
Utilizing High Velocity Jets for Wake Refinement in Ground Vehicles

Domenic Barsotti
MSME
Embry-Riddle Aeronautical University

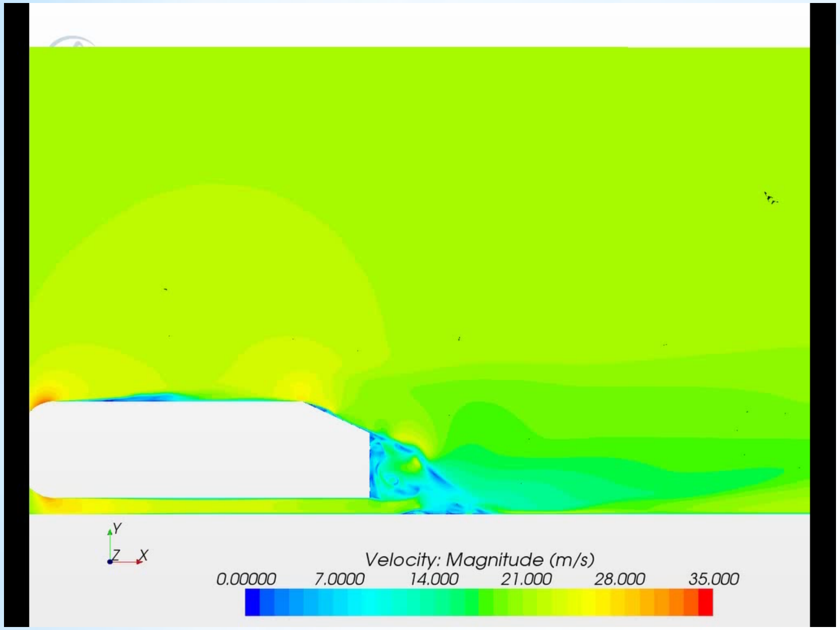
Optimized Results

* Averaged Cd = 0.316 (12% reduction)
* Jet velocity of 10.28 m/s

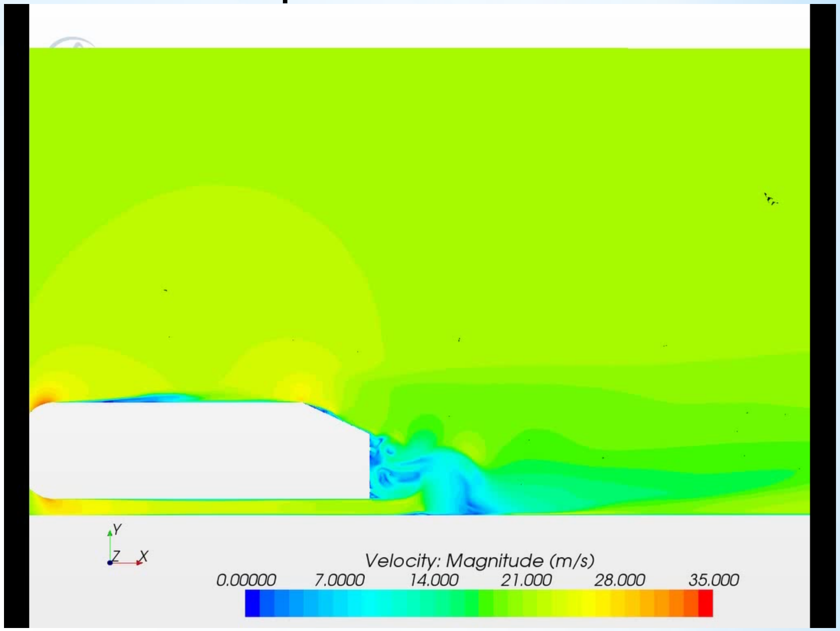




No Jets



Optimized Jets



Optimized Results

OPTIMIZE THIS! 2012
World's Leading Optimization Conference | Detroit 2012

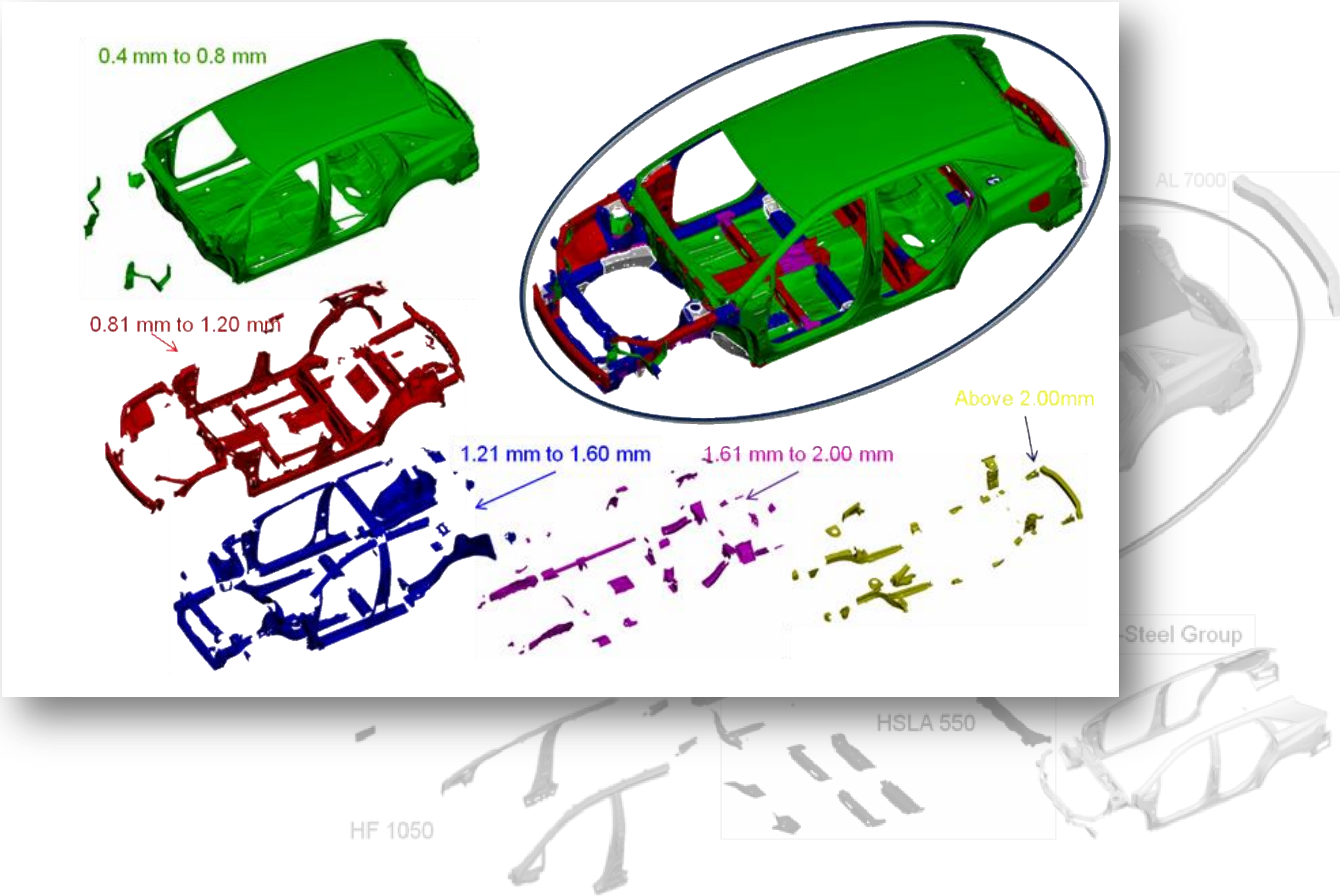
EDAG

Light Weight Design Optimization of Vehicle BIW, Strategy and Application

Velayudham Ganesan
Program Manager, EDAG Inc.
October 2012

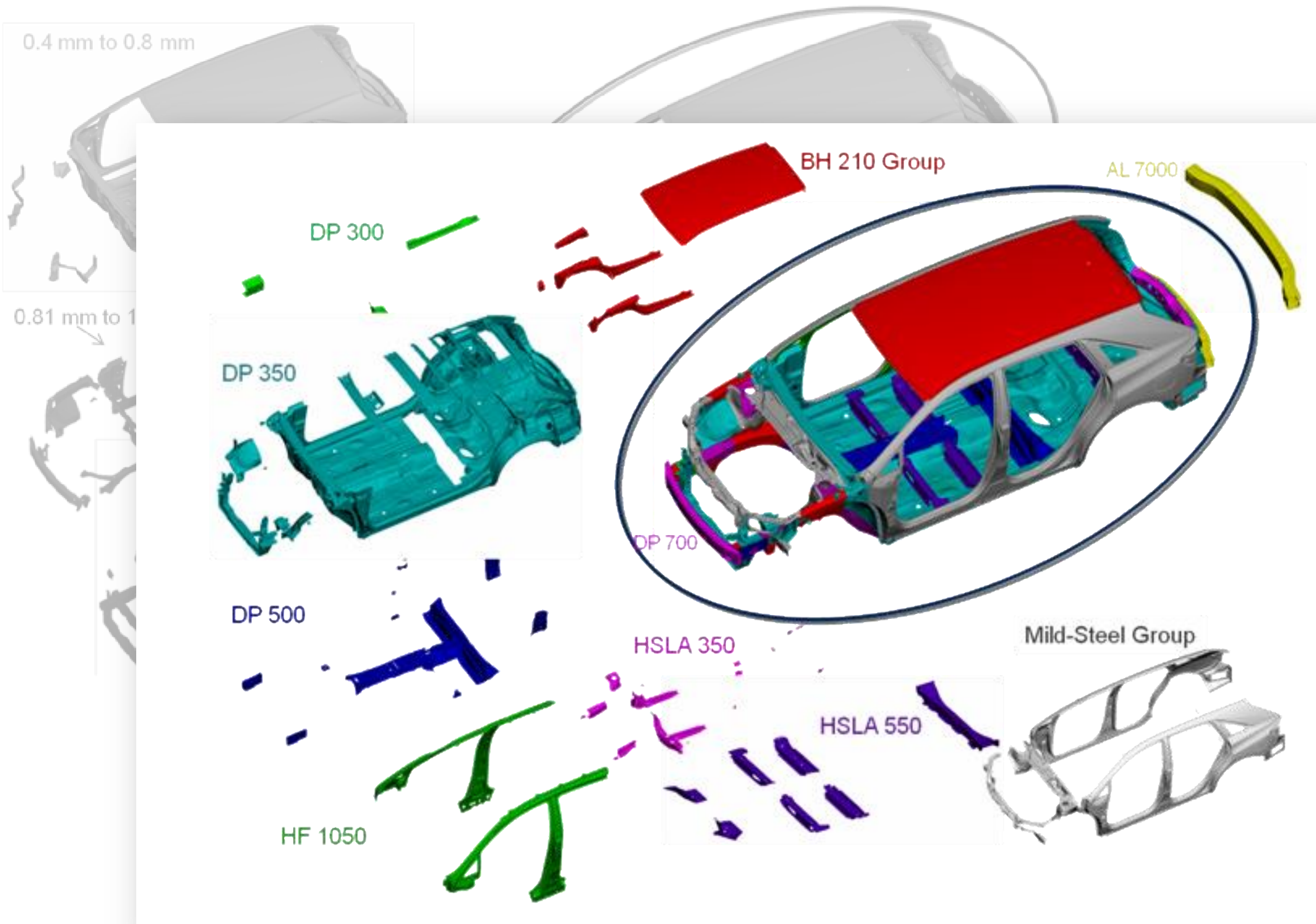
Javier Rodríguez
Director Vehicle Integration, EDAG Inc.

System Weights and Materials



			Weight Reduced System-Mass (Kg)
			53.2
			42.4
			10.1
			7.7
			4.9
			118.3
			32.0
			36.2
			24.1
			141.9
			90.2
			324.4
			0.7
			3.2
			4.4
			8.3
			4.7
			2.4
		Sub-Total	**7.5**	**7.1**
		Total Weight	**528.9**	**458.1**

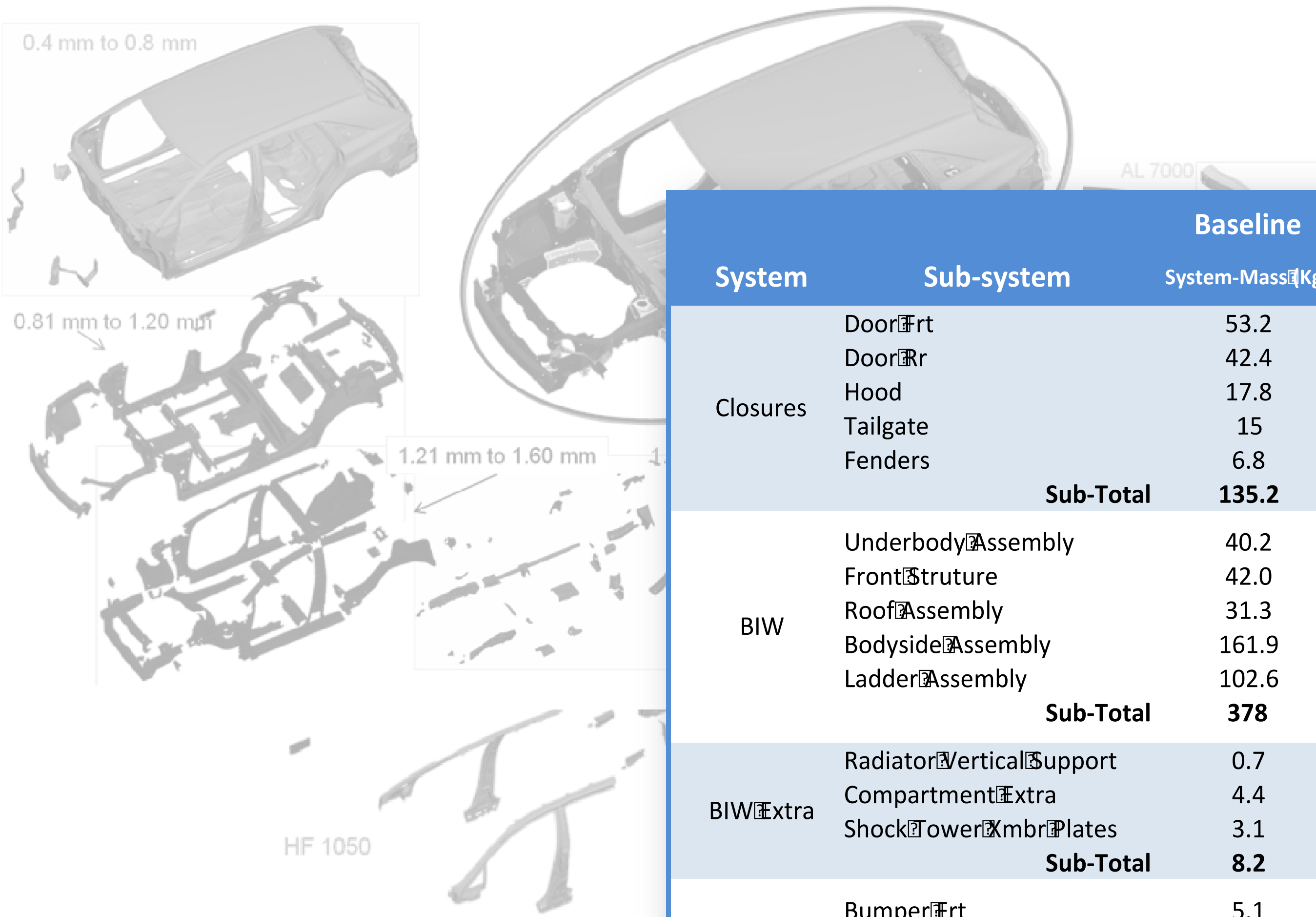
Optimized Gauge Map



		Weight Reduced System-Mass (Kg)
		53.2
		42.4
		10.1
		7.7
		4.9
		118.3
		32.0
		36.2
		24.1
		141.9
		90.2
		324.4
		0.7
		3.2
		4.4
		8.3
		4.7
		2.4
Sub-Total	7.5	7.1
Total Weight	528.9	458.1

Optimized Material Map

Optimized Model
System Weights and Materials



System	Sub-system		Baseline System-Mass (Kg)	Weight Reduced System-Mass (Kg)
Closures	Door Frt		53.2	53.2
	Door Rr		42.4	42.4
	Hood		17.8	10.1
	Tailgate		15	7.7
	Fenders		6.8	4.9
		Sub-Total	**135.2**	**118.3**
BIW	Underbody Assembly		40.2	32.0
	Front Struture		42.0	36.2
	Roof Assembly		31.3	24.1
	Bodyside Assembly		161.9	141.9
	Ladder Assembly		102.6	90.2
		Sub-Total	**378**	**324.4**
BIW Extra	Radiator Vertical Support		0.7	0.7
	Compartment Extra		4.4	3.2
	Shock Tower Xmbr Plates		3.1	4.4
		Sub-Total	**8.2**	**8.3**
Bumpers	Bumper Frt		5.1	4.7
	Bumper Rr		2.4	2.4
		Sub-Total	**7.5**	**7.1**
		Total Weight	**528.9**	**458.1**

13.4 % mass savings

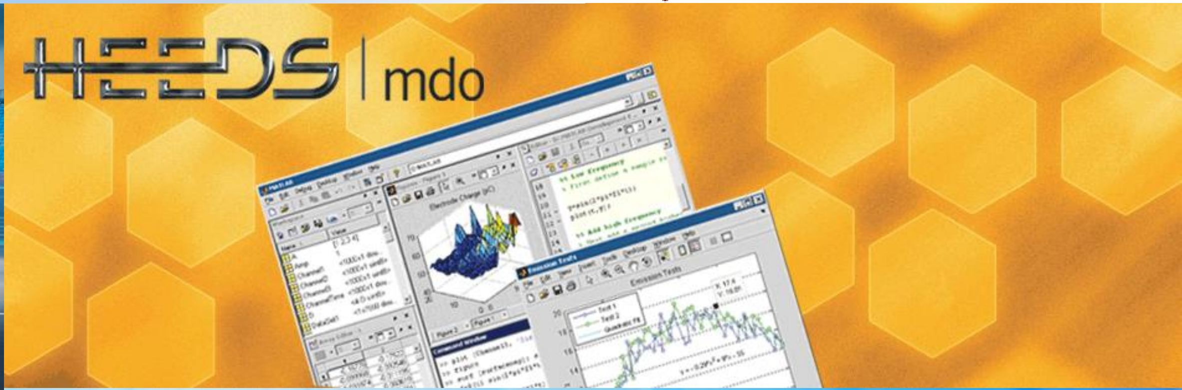
Optimized Sub-Systems Weights

CAE Value AB

Using HEEDS to Drive Auto-correlation of Suspension Elastokinematics

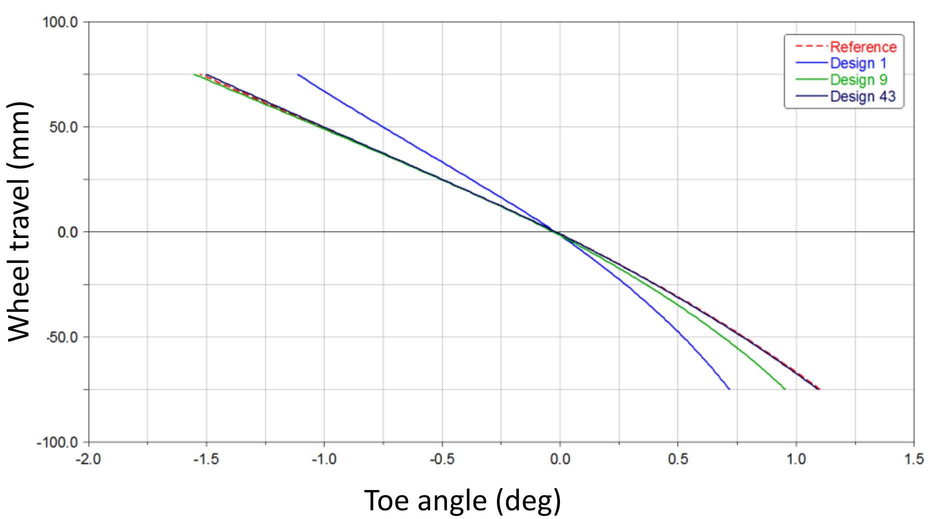
David Fredriksson Johnny Engström Gabriel Palmenäs

OPTIMIZE THIS! 2012
World's Leading Optimization Conference | Detroit 2012

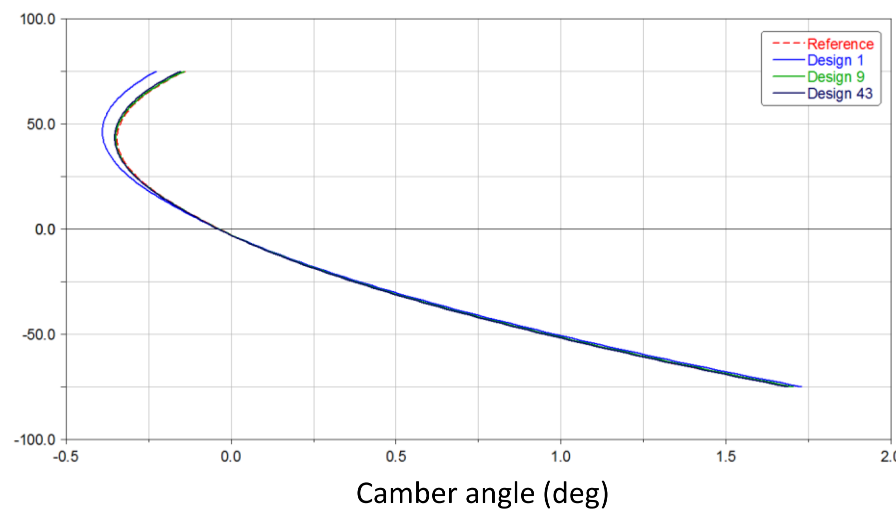


Results – Parallel wheel travel

- Toe



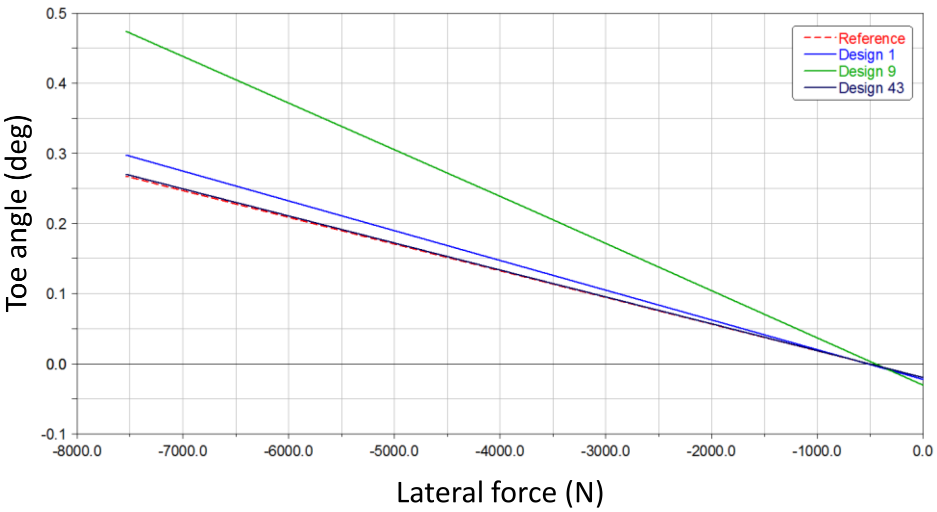
- Camber

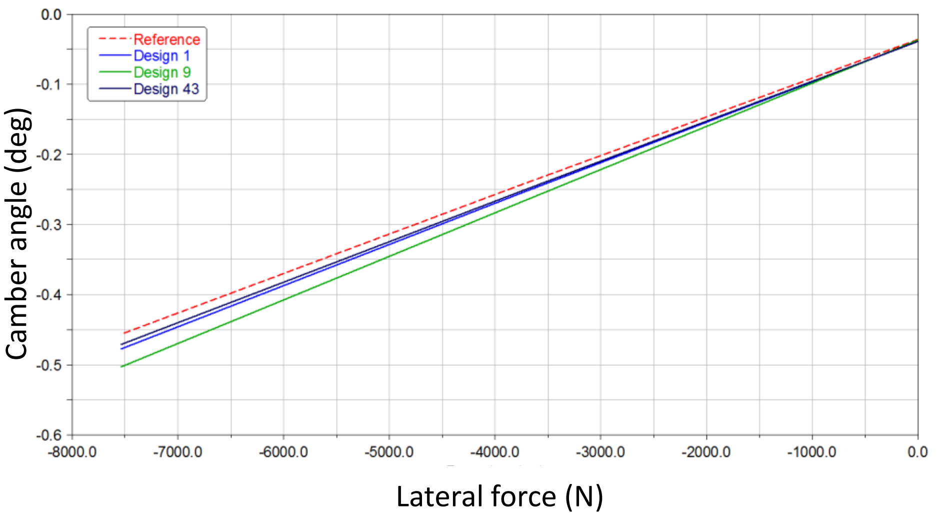


David Fredriksson
dfred@caevalue.com
Johnny Engström
jengs@caevalue.com
Gabriel Palmenäs
gpalm@caevalue.com

Results – Cornering force

- Toe
- Camber





David Fredriksson
dfred@caevalue.com
Johnny Engström
jengs@caevalue.com
Gabriel Palmenäs
gpalm@caevalue.com
CAE Value AB
Optimization Driven Innovation

Results

	Reference	Design 1	Design 43	Diff Design 1	Diff Design 43	Improvement
Toe @ max bump	-1.5271	-1.1156	-1.5035	0.4115	0.0236	94.3%
Toe grad @ 0	-0.0191	-0.0222	-0.0197	-0.0031	-0.0006	80.6%
Toe @ max rebound	1.1026	0.7174	1.0945	-0.3852	-0.0081	97.9%
Camber @ max bump	-0.1389	-0.2265	-0.1528	-0.0876	-0.0139	84.1%
Camber grad @ 0	-0.0126	-0.0134	-0.0127	-0.0008	-0.0001	87.5%
Camber @ max rebound	1.6867	1.7295	1.6873	0.0428	0.0006	98.6%

David Fredriksson
dfred@caevalue.com
Johnny Engström
jengs@caevalue.com
Gabriel Palmenäs
gpalm@caevalue.com
CAE Value AB
Optimization Driven Innovation

Delivering race winning performance with HEEDS®MDO and VI-MotorSport

David Ewbank
Zouch Dynamics Ltd

Conclusions

- MG KX Momentum Racing has exceeded its ambitions in 2012 and is currently challenging for the drivers championship
- Use of HEEDS®MDO and VI-MotorSport have played a key part in this success
- Setup guidance provided to team, based on hundreds of HEEDS®MDO and VI-MotorSport simulation evaluations, has proven to be a valuable replacement for past knowledge
- Results from simulation have translated into success on the track without undertaking expensive correlation exercises
- Enabled quick evaluation of development ideas, particularly those requiring unconventional car setup
- Methods used with MG KX Momentum Racing can just as easily be applied by other teams and different race series and be equally effective

Jason Plato on Silverstone 2012

"Despite the retirement in race two this is still one of the best days in my BTCC career. We've made more progress with our MG6 – in fact it's a rocketship – and our tails are well and truly in the air. For MG to go into the final round with a chance of lifting the title in its first year back in the championship is fantastic and I really believe we've got the Honda boys worried."

Jason Plato, Driver at **MG KX Momentum Racing**.

Development of Multidisciplinary Design Optimization Process for a Large Scale Hybrid Composite Wind Turbine Blade

Jin Woo Lee[*], Sathya Gangadharan[§], Maj Mirmirani[†], Somanath Nagendra[‡]

[*] Graduate Student, The University of Toledo, Toledo, Ohio
[§] Professor of Mechanical Engineering, Embry-Riddle Aeronautical University, Daytona Beach, Florida
[†] Dean of College of Engineering, Embry-Riddle Aeronautical University, Daytona Beach, Florida
[‡] Pratt and Whitney Jet Engines, United technologies Corporation, East Hartford, Connecticut

Optimum Design

Responses	Baseline Design	Optimum Design	% difference
Performance Rate	-0.345138	-0.131959	61.77
Blade Length (in)	337	5526.8	1540.00
Weight (lb)	251.434	1446963.488	575384.39
Annual Energy Production (kWh)	432270	116263408	26796.00
Power Production Rate ($/kW)	1335.22	2644.95	98.09
20 Years Lifetime Profit ($)	888564.88	221605642.73	24839.73

Design Variables		Baseline Design				Optimum Design			
Scale Factor		1				16.4			
Thickness (in)	Root Fitting	0.154792				0.755			
	Spar	Glass Fiber		Carbon Fiber		Glass Fiber		Carbon Fiber	
		0		0		2.749		3.203	
	Station	Top		Bottom		Top		Bottom	
		Glass Fiber	Carbon Fiber	Glass Fiber	Carbon Fiber	Glass Fiber	Carbon Fiber	Glass Fiber	Carbon Fiber
	1	0.375	0	0.375	0	1.571	0	1.528	2.7
	2	0	0.0591	0	0.0591	6.388	1.237	6.383	2.336
	3	0	0.093575	0	0.093575	3.34	0.96	4.82	0.588
	4	0	0.123125	0	0.123125	5.423	0	1.553	0.328
	5	0	0.10835	0	0.10835	2.649	0.227	0.974	0.13
	6	0	0.083725	0	0.083725	1.519	0.167	0.916	4.25
	7	0	0.083725	0	0.083725	1.299	0.054	1.603	0.115
	8	0	0.064025	0	0.064025	4.925	1.04	1.562	1.449
	9	0	0.044325	0	0.044325	0.42	0.188	0.122	1.742
	10	0	0.044325	0	0.044325	1.885	0.5	3.576	1.441
	11	0	0.034475	0	0.034475	3.262	0.692	0.282	0.39
	12	0	0.034475	0	0.034475	3.504	0.533	0.915	1.822
	13	0	0	0	0	4.058	0.168	2.247	0.353

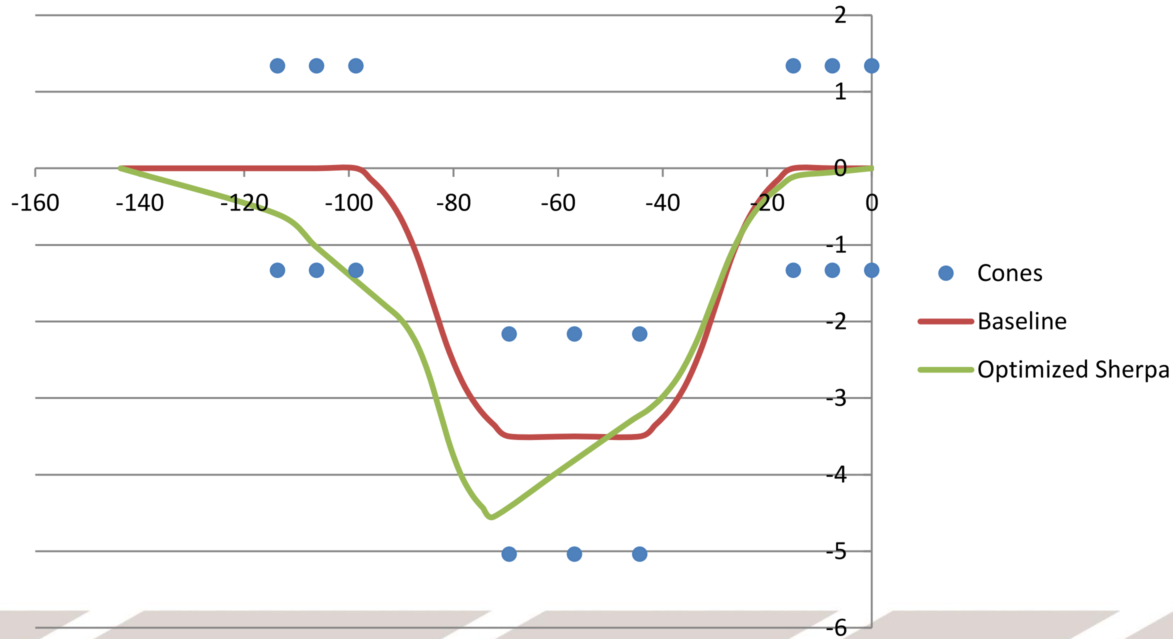
PRATT & MILLER

Path Optimization using ADAMS/Car and HEEDS/MDO

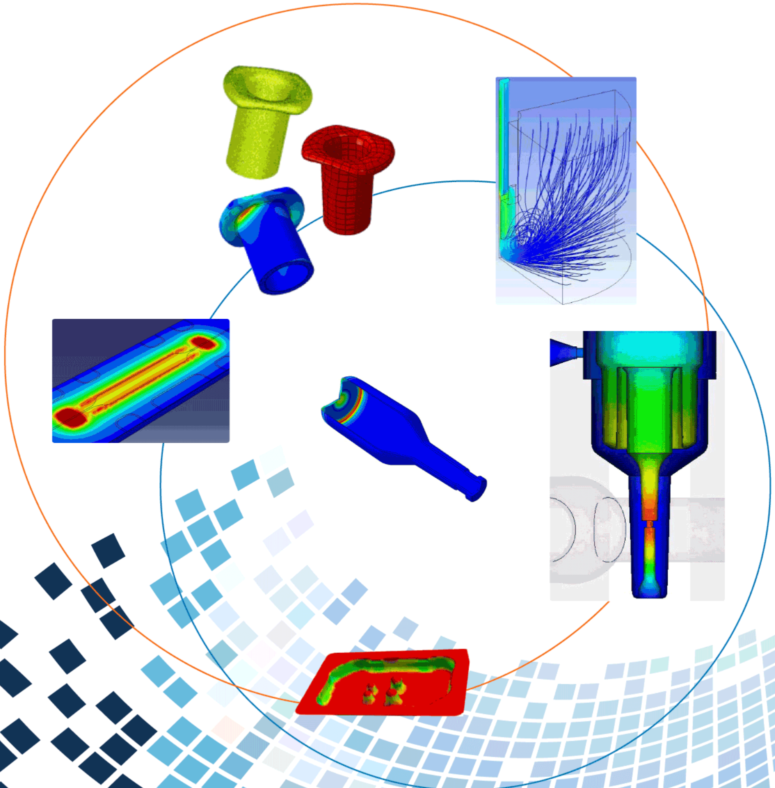
Jesper Slattengren
Manager, Modeling & Simulation
Pratt & Miller Engineering
jslat@prattmiller.com

Different problem (cont.)

- Starting from "nominal trajectory"
- QP or Simplex did not converge, solution too far off from baseline
- SHERPA found a solution in 149 evaluations



Design of a Snap-Fit Mechanism Using Finite Element Analysis (FEA) in Combination with SHERPA



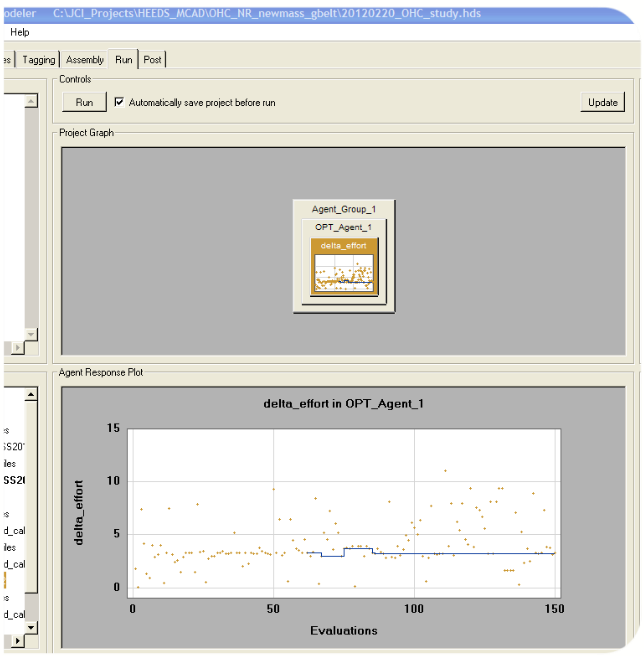
Arun Nair, Anita Bestelmeyer, Sandeep Tripathi
BD
Ranny Sidhu (Red Cedar Technology)
International HEEDS User Conference
Detroit, October 2012

Conclusions

- The final product design has been launched successfully and resulted in significant cost savings, in the order of millions of dollars.
- This design effort was extensively guided by non-linear FEA based optimization using HEEDS and SHERPA.
- Following this effort, several other FEA based design optimization studies have been completed successfully at BD.
- This methodology is very effective, especially when physical prototyping and/or discrete FEA may not be sufficient to yield the desired solution.
- Simulation based optimization offers a novel way to identify innovative product designs and reduce development time and costs.

Optimize This! 2012 Presentation

Using HEEDS with MathCad for Sunglass Bin Door Optimization



Johnson Controls

HEEDS with MathCad
Conclusion

Time Saved

- HEEDS Solution: 24 hrs (8 hrs set-up, 16 hrs run time)
- Manual Solution: ~ 2 weeks

- **Optimized Solution**

- HEEDS (SHERPA) – expertly searches design space
- Manual (Engineer) – hard to be sure if optimized

- **HEEDS, coupled with MathCad, not only automates the engineering design process, saving valuable engineering time, it also quickly finds optimal solutions, saving money.**

Understanding the Effect of Vehicle Front End Styling Changes on Flex PLI Injury

Using a Simple Spring Model and HEEDS MDO

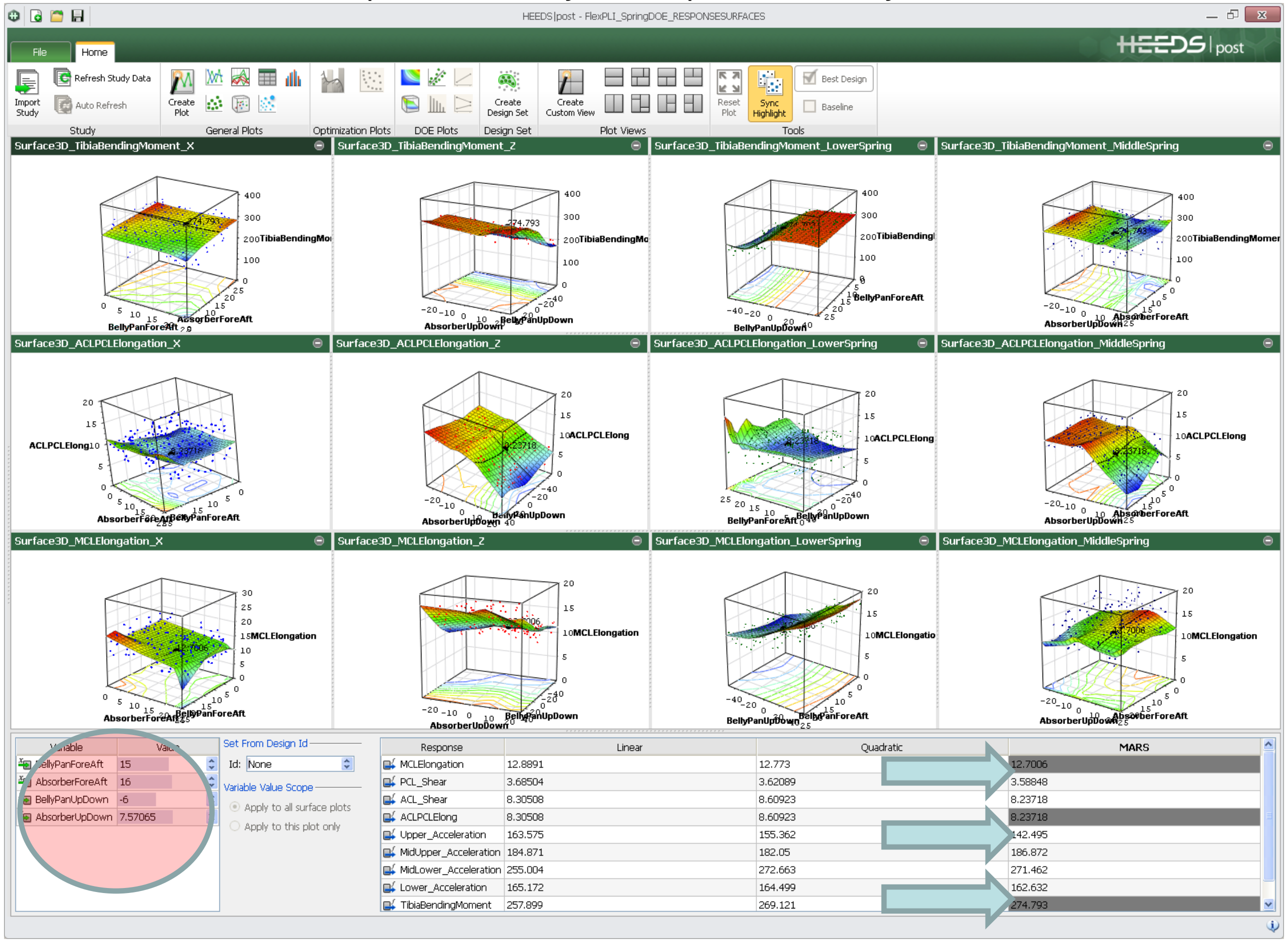
HEEDS POST as an Engineering Tool for Balancing Tradeoff between Styling and Safety

Variables

Fore-Aft – Absorber Fore-Aft – Belly Pan	Up-Down – Absorber Up-Down – Belly Pan	Fore-Aft – Belly Pan Up-Down – Belly Pan	Fore-Aft – Absorber Up-Down – Absorber

Response

- Tibia Bending Moment
- ACL/PCL Elongation
- MCL Elongation



Response	Linear	Quadratic	MARS
MCLElongation	12.8891	12.773	12.7006
PCL_Shear	3.68504	3.62089	3.58848
ACL_Shear	8.30508	8.60923	8.23718
ACLPCLElong	8.30508	8.60923	8.23718
Upper_Acceleration	163.575	155.362	142.495
MidUpper_Acceleration	184.871	182.05	186.872
MidLower_Acceleration	255.004	272.663	271.462
Lower_Acceleration	165.172	164.499	162.632
TibiaBendingMoment	257.899	269.121	274.793

ACP™

Accelerated Concept → to Product Process

Applied to

FutureSteelVehicle

Nature's Way to Mobility

Manufacturing Solutions – 3B Optimization

red cedar TECHNOLOGY

1st HEEDS User Conference
October 17th, 2012

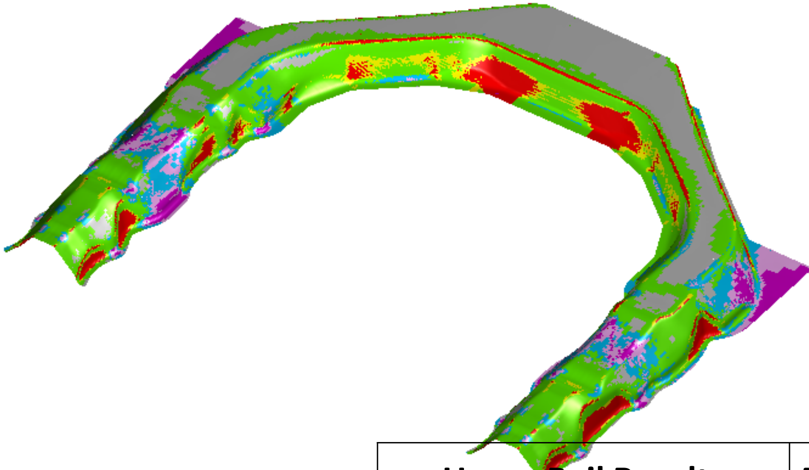
Jody Shaw, Director, Marketing & Product Development, U. S. Steel
Akbar Farahani, Ph.D , Vice President Engineering , ETA Inc.

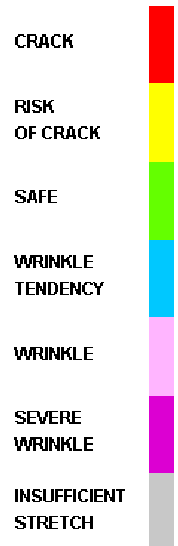
WorldAutoSteel

eta

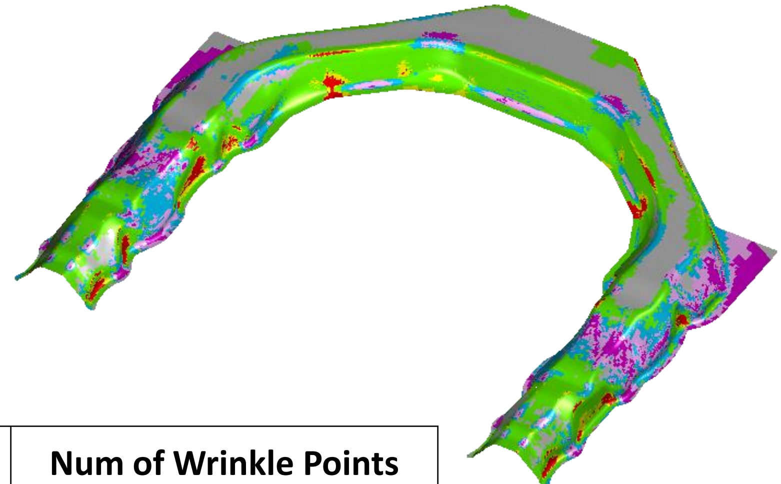
Step2- Upper Rail 3B Forming Process Results

Baseline

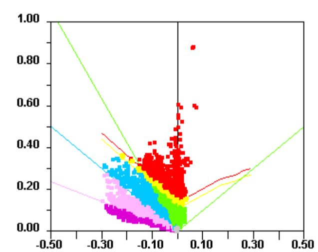




Design 1959



Upper Rail Results	Num of Crack Points	Num of Wrinkle Points
		–
Baseline	3017	3253
Design 1959	88	117



WorldAutoSteel

eta

ACP™
Accelerated Concept
—› to Product Process

Future of Product Design Development Applied to :

FutureSteelVehicle

Nature's Way to Mobility

red cedar TECHNOLOGY

1st HEEDS User Conference
October 17th, 2012

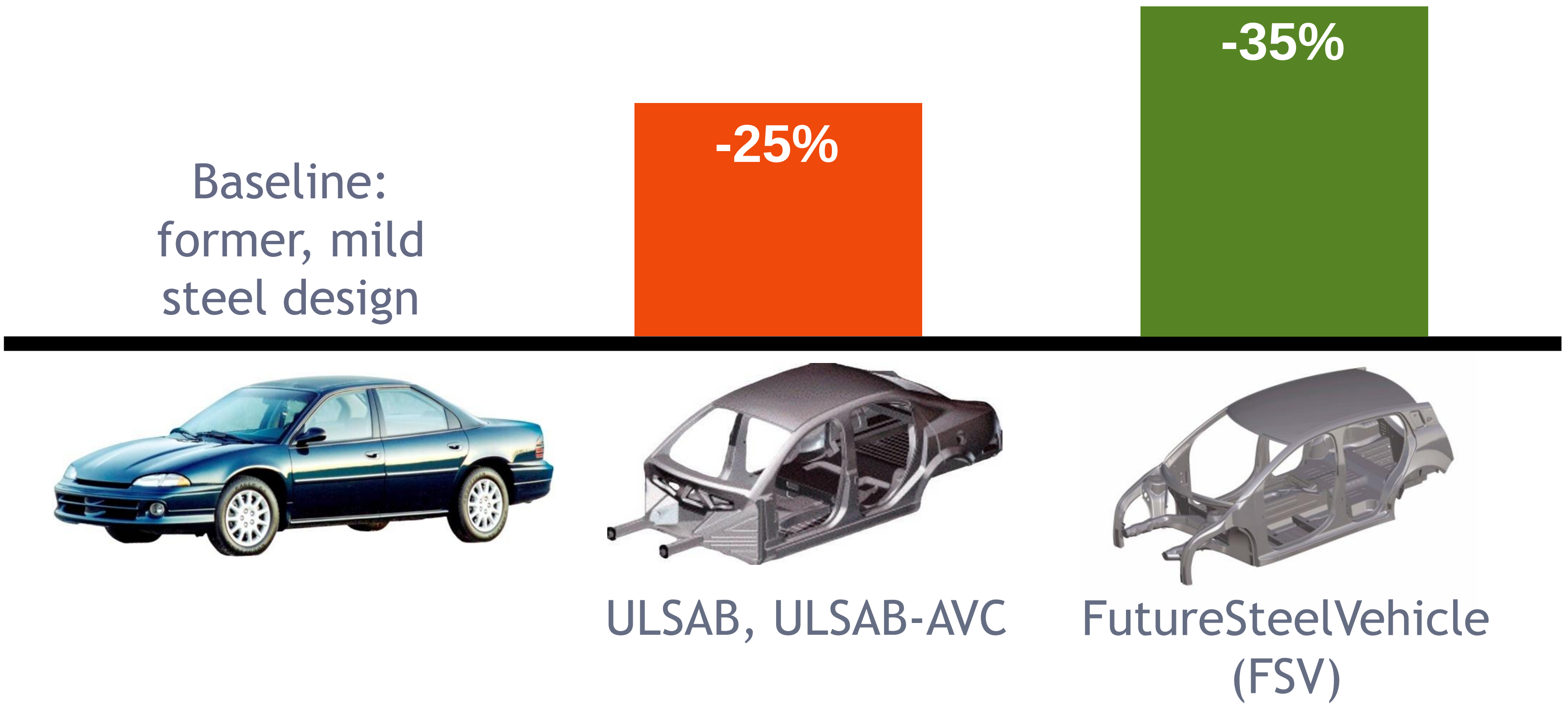
Akbar Farahani, Ph.D , Vice President Engineering , ETA Inc.
Jody Shaw, Director, Marketing & Product Development, U. S. Steel

WorldAutoSteel

eta

Design for Mass Reduction

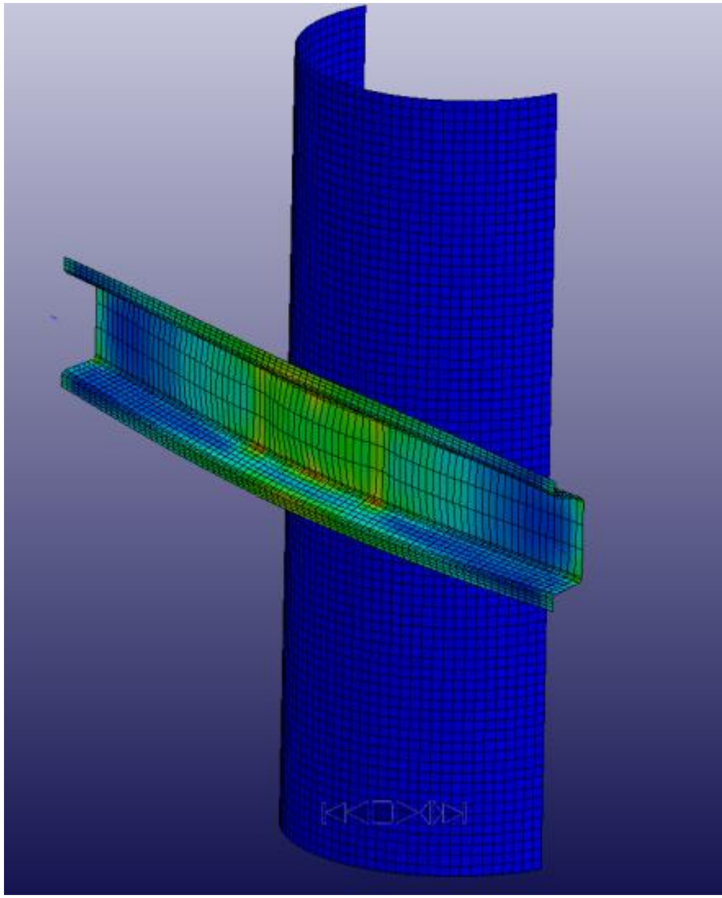
Raising the Bar in Vehicle Mass Reduction



CAE Optimization in the Cloud

rod@totalcae.com

Cloud Case Study
Beam Optimization with HEEDS



WorldAutoSteel

eta

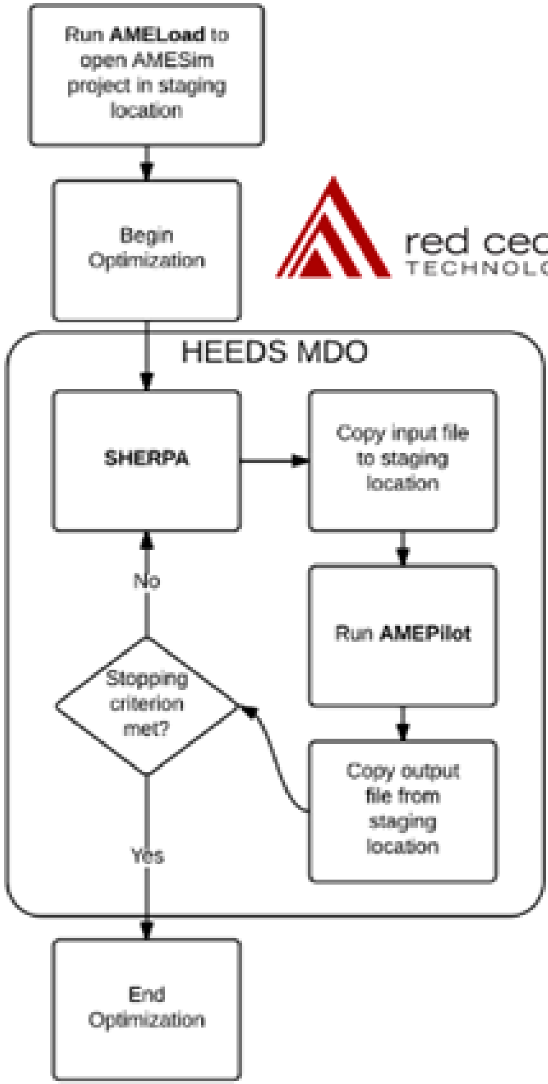
Multi-attribute thermal balancing on an electric vehicle, focusing on comfort and fuel economy

Hari Vijay, LMS

LMS
ENGINEERING INNOVATION

Optimization for thermal comfort using HEEDS

- Cold air from the HVAC system is used for cabin cooling and battery cooling
- Tuning of the bypass orifice is important for passenger comfort and thermal battery efficiency
- HEEDS is used for optimizing the bypass valve



12

NEW WORLD

ENGINEERING INNOVATION

