

HyperWorks - The FEA Toolset for Academia

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Content

- Diversity
- Activity Led Learning
- Analytical Modelling at Coventry University
- Why HyperWorks?
- Application of Activity Led Learning Using HyperWorks / Research

Diversity

- Undergraduates: 70% European students , 30% international
- Postgraduates: 80% International students, 20% from Europe
- Some research has shown that the main problem is of cultural in origin:
 - The attendance to the lectures is not compulsory
 - The student has to work extra hours to complement the teaching provided (usually 2 to 3h per hour of teaching)
 - The method of assessment (coursework) is not the same as exams (problems with deadlines and schedules)

Diversity

- Cultural problems:
 - “Social-cultural adjustment: ...stress created to adjusting to the new culture
 - Language: some students’ English is very poor. One cannot learn and interact deeply if the medium of communication is not adequate
 - Learning/teaching due to culture:
 - too teacher dependant, too uncritical, prone to rote memorization.
 - do not understand plagiarism
 - international student response to lectures can be inexistent
 - reluctant to discuss, criticize reading and express and opinion

Diversity

- Coventry University has an inclusive policy on teaching and education
- A new teaching method called Activity Led Learning is born:

*I hear and I forget
I see and I remember
I do and I understand. ...*

Chinese Proverb

Activity Led Learning

- Activity Led Learning is a pedagogy in which the activity is the focal point of the learning experience and the tutor acts as a facilitator.
- An activity is a problem, project, scenario, case-study, enquiry, research question (or similar) in a class-room, work-based, laboratory-based or other educational context and for **which there a range of possible solutions or responses.**

Wilson-Medhurst (2008)

Activity Led Learning

- Activities may cross subject boundaries, as activities within professional practice often do.
- Activity Led Learning requires a self-directed process in which the individual learner, or team of learners, seek and apply knowledge, skilful practices, resources (personal and physical) relevant to the activity being undertaken.

Wilson-Medhurst (2008)

Activity Led Learning

- Activity Led Learning is a new way of educating engineers for the future by equipping them with the skills which industry wants.
- It is designed to give them experience of solving real problems against real deadlines, using practical skills, team-working and creativity.

Activity Led Learning



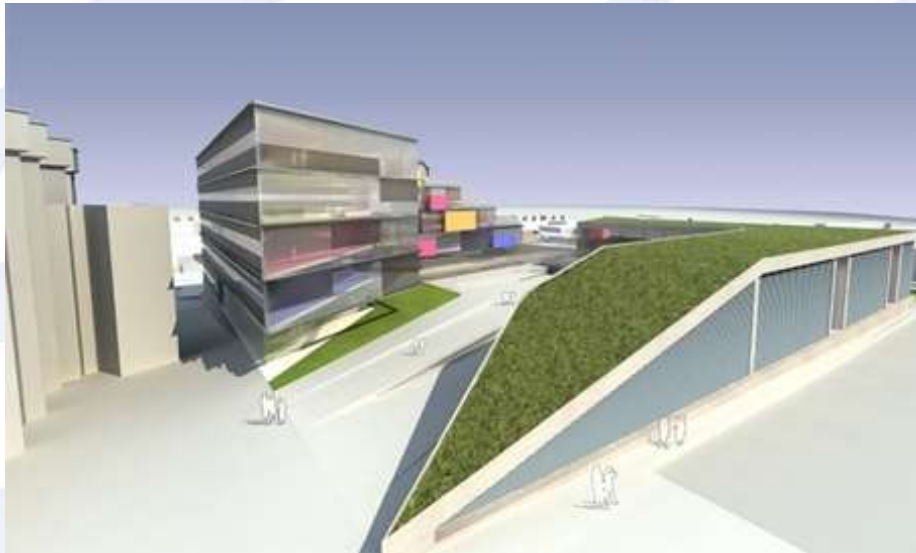
“A small number of UK institutions - most notably, in recent years, the *Faculty of Engineering and Computing* at Coventry University are undertaking more extensive and structured re-designs of their undergraduate education that incorporate significant ALL activities.

Although Coventry is clearly looking at the international rather than national stage in their vision, if successful, they are well placed to become a UK-leader in engineering ALL.”

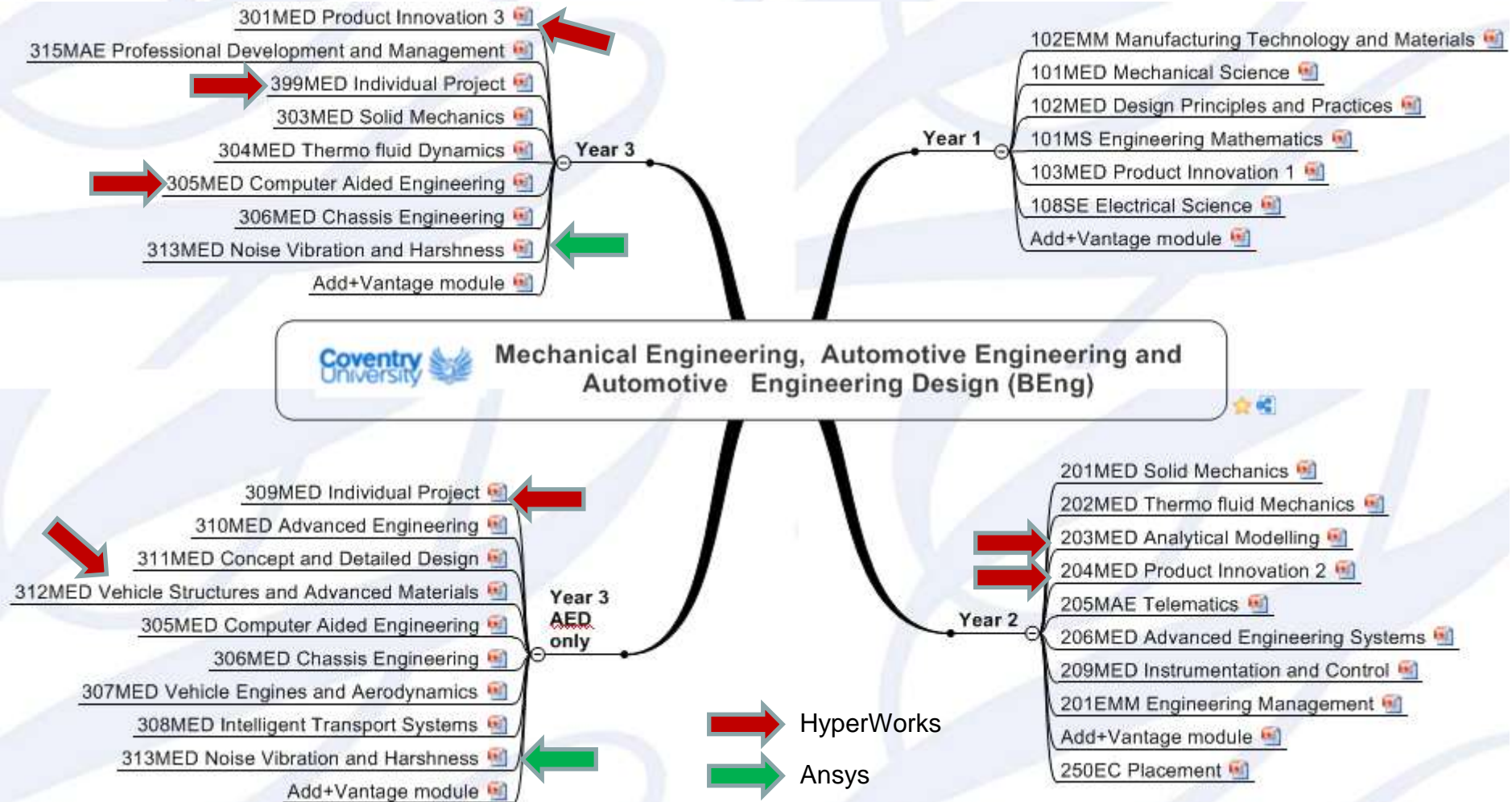
(MIT review of UK engineering project-based learning, authored by Dr Ruth Graham, 2010)

Activity Led Learning

- Investment in £52m in new Activity Led Learning Engineering Building (2012)



Undergraduate Modules



Postgraduate FEA

Module Credit/ Course	Automotive Engineering (045)	Mechanical Engineering (048)	Future Transport Engineering (071)	Defence and Security Engineering (070)	Vehicle Dynamics (050)	Vehicle Structures and Safety (051)	Engine Design and Development (046)	Motorsport Engineering (049)
SEMESTER 1 – Long Thin SMS 14 week modules								
15	Engineering Project Management	Engineering Project Management	Engineering Project Management	Engineering Project Management	Engineering Project Management	Engineering Project Management	Engineering Project Management	Engineering Project Management
15	Computer Aided Engineering	Computer Aided Engineering	Computer Aided Engineering	Advanced Computer Aided Engineering	Advanced Computer Aided Engineering	Advanced Computer Aided Engineering	Advanced Computer Aided Engineering	Advanced Computer Aided Engineering
15	Vehicle Refinement	Stress and Dynamics	Alternative Propulsion Systems	Defence, Security and Technology	Advanced Engineering Simulation	Advanced Engineering Simulation	Advanced Engineering Simulation	Data Systems for Motorsport
15	Advanced Manufacturing Processes and Materials	Advanced Manufacturing Processes and Materials	Materials Design and Manufacture	Materials Design and Manufacture	Vehicle Dynamics Handling and Simulation	Advanced Manufacturing Processes and Materials	Advanced Manufacturing Processes and Materials	Engineering Management in Motorsport
SEMESTER 2 – Long Thin SMS 14 week modules								
15	Powertrain and Engine Dynamics	Thermofluid Systems	Vehicle Structures and Aerodynamics	Structures, Safety and Impact	Vehicle Instrumentation and Testing	Structures, Safety and Impact	Powertrain and Engine Dynamics	Composite Materials and Manufacture
15	Vehicle Structures and Aerodynamics	Mechanical Systems Control Engineering	Intelligent Transport Systems	Intelligent Transport Systems	Mechanical Systems Control Engineering	Vehicle Structural Design and Analysis	Mechanical Systems Control Engineering	Engine Design and Performance
30	Automotive Systems Design Group Project	Mechanical Engineering Design Group Project	Future Transport Engineering Group Project	Defence and Security Engineering Group Project	Vehicle Dynamics Group Project	Vehicle Structures and Safety Group Project	Engine Design and Development Group Project	Motorsport Engineering Group Project
60	SEMESTER 3 - MAE Individual Masters Project (Including Research Methods)							



HyperWorks



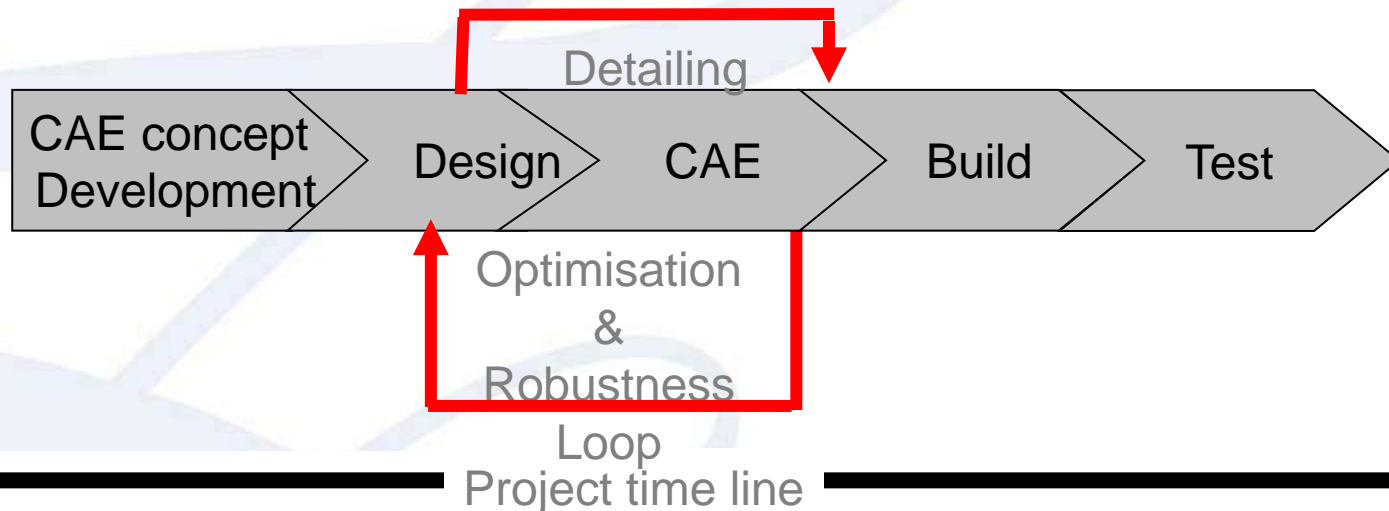
Catia FEA (mostly) + Ansys



HyperWorks + LS-Dyna

Why HyperWorks ?

- HW is not just a Finite Element software:
 - It has an engineering feel to it
 - It enables the teaching of the right design method (shortening design loop)



Why HyperWorks ?

- It is more like an Analysis/ Design Hub
 - Excellent I/O interfaces with external software
 - Optimisation (topology, topography etc...) tools which makes the learning of FEA interesting and relevant for the students
 - Universal Post-processor (HyperView)
 - Integration (Excel, LS-Dyna, Adams, Madymo etc...) within HyperStudy

Why HyperWorks ?

- Includes Manufacturing tools (HyperForm)
- Very affordable
- 2000 tokens = 40 OptiStruct licences or 90 HyperMesh licences (flexible solution).
- Have not yet ran out of licences compared to Catia, StarCCM+

Why HyperWorks ?

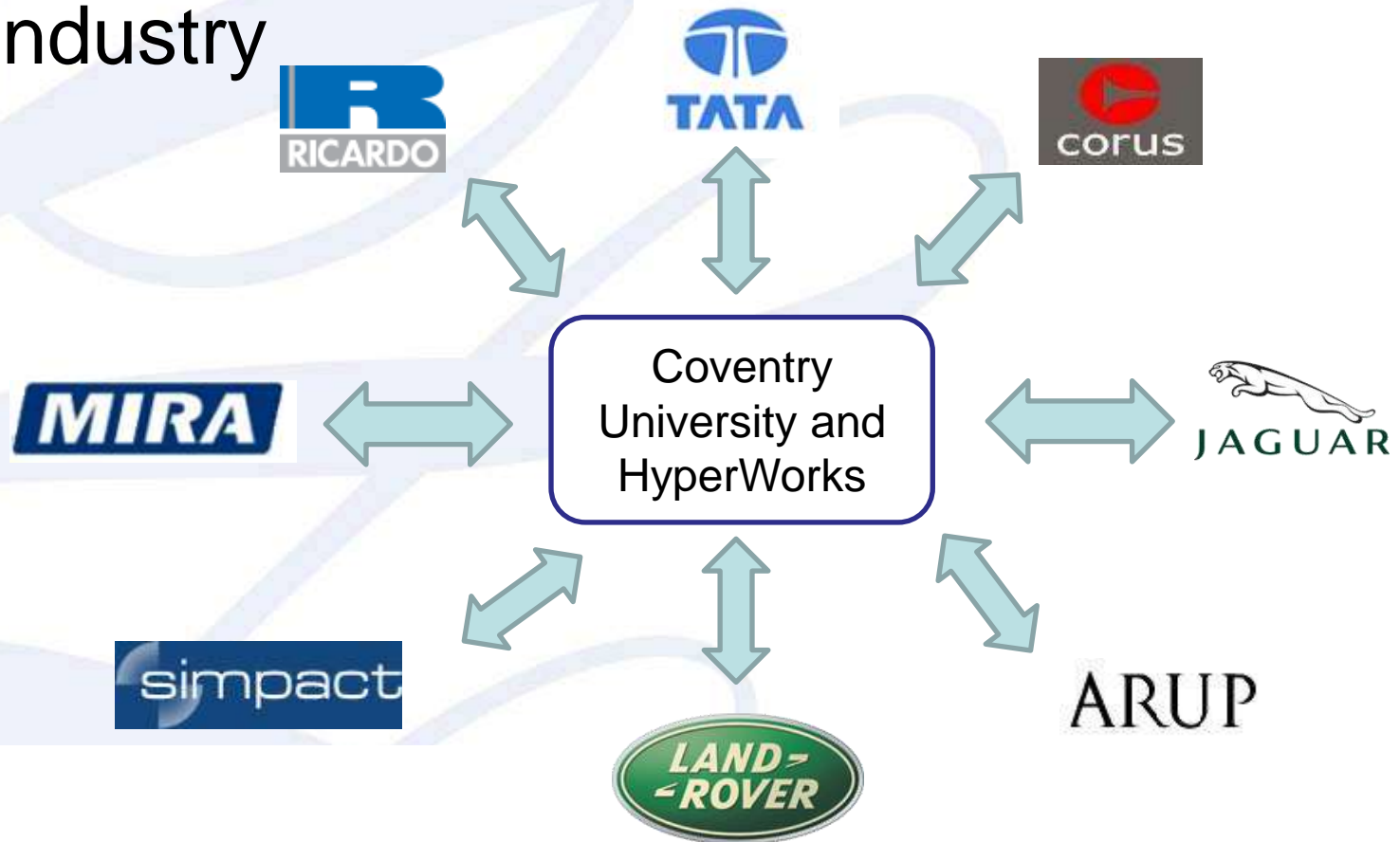
- Automatic conversion of Nastran (industry standard) input decks into OptiStruct



- ‘Strategic’ decision: now local industry is interested in proposing student projects

Why HyperWorks ?

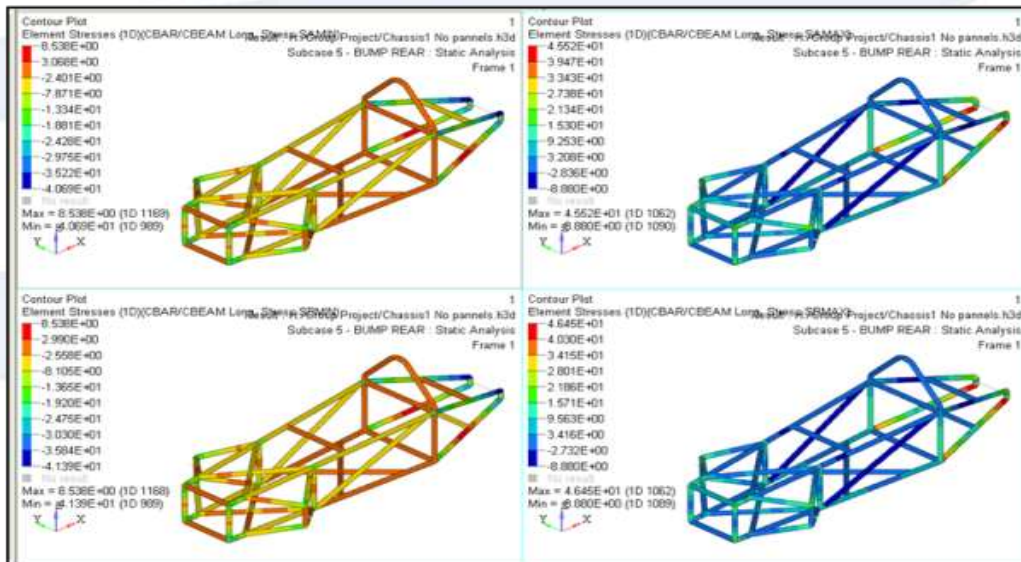
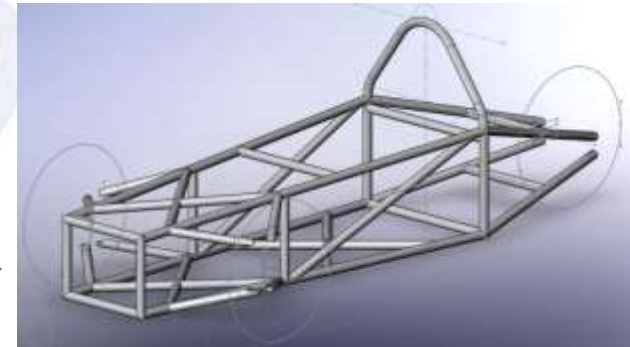
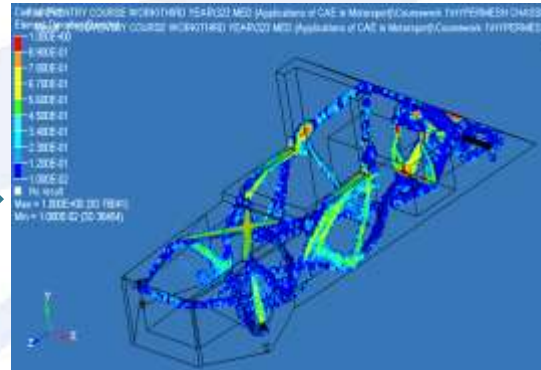
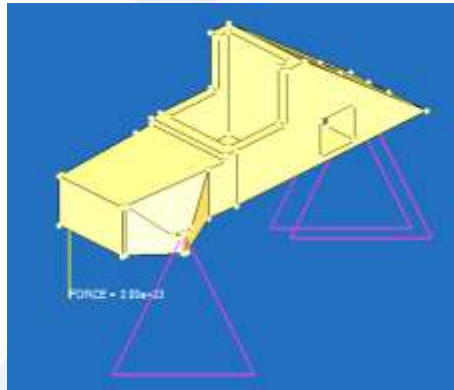
- Huge user base in the UK automotive industry



Why HyperWorks ?

- HyperWorks enthuses the students with interest, excitement and relevance, changing from a blackboard teaching approach to industrial techniques and applications.

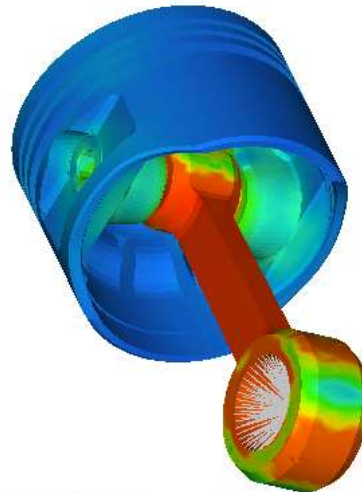
Shell Eco Marathon 2010



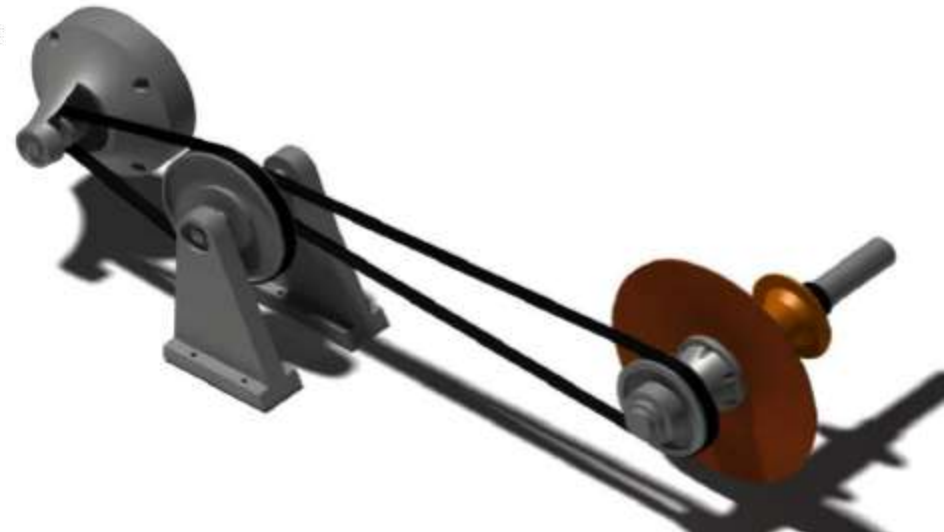
Shell Eco Marathon 2010

Contour Plot
Element Stresses (2D & 3D)(vonMises)

Analysis system
Simple Average
3.345E+02
4.560E+01
3.909E+01
3.257E+01
2.606E+01
1.954E+01
1.303E+01
6.514E+00
0.000E+00
-6.514E+00
No result
Max = 3.345E+02
Global 158701
Min = 1.044E-01
Global 140002

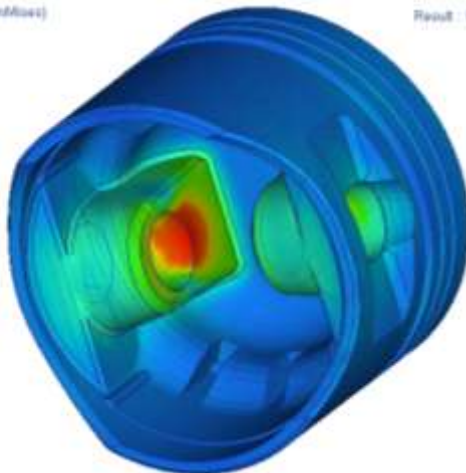


Result :



Element Stresses (2D & 3D)(vonMises)

Analysis system
Simple Average
9.318E+01
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3.257E+01
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1.303E+01
6.514E+00
0.000E+00
-6.514E+00
No result
Max = 9.318E+01
Global 148149
Min = 1.044E-01
Global 140002



Result : C/F

Contour Plot
Displacement (mm)

Analysis system
Simple Average
-1.044E-01
0.000E+00
1.044E-01
2.088E-01
3.132E-01
4.176E-01
5.220E-01
6.264E-01
7.308E-01
8.352E-01
9.396E-01
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





Shell Eco Marathon 2010

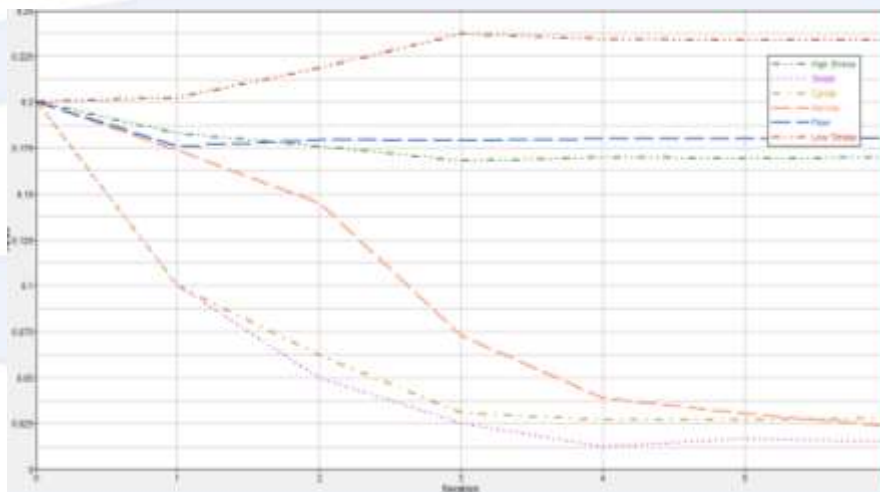
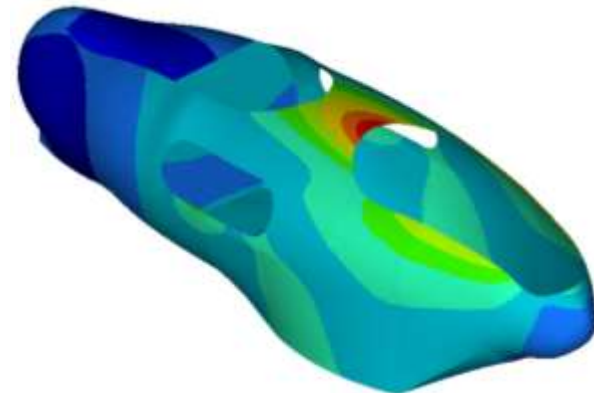
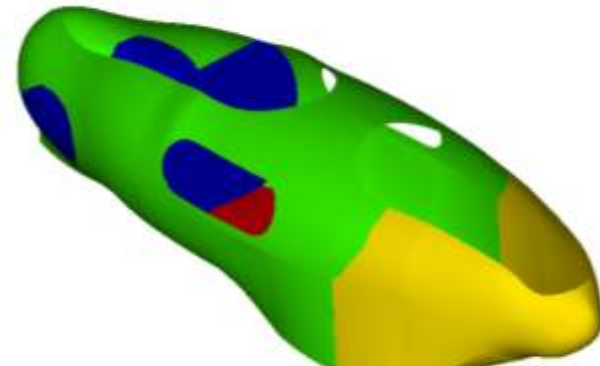
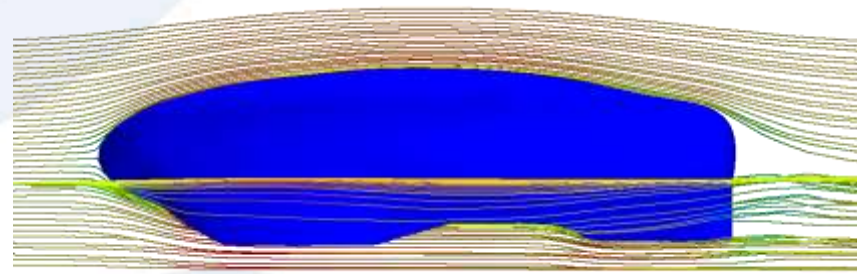


From 0 to 981mpg in 2 years!

Shell Eco Marathon 2011

Total number of plies: 8
Total thickness: 1.6

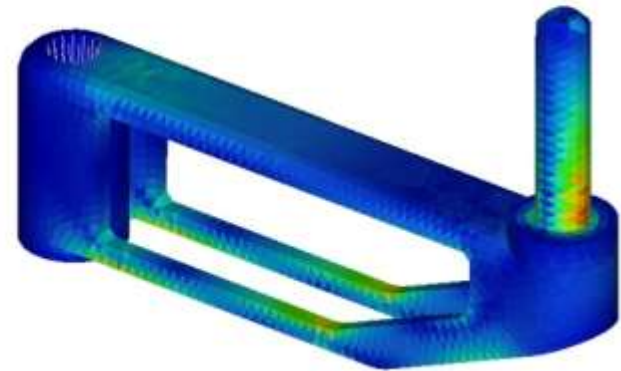
	Ply	Material	Thickness T1	Orientation Degrees
	1	HS Carbon 12K	0.2	0.0
	2	HS Carbon 12K	0.2	90.0
	3	HS Carbon 12K	0.2	45.0
	4	HS Carbon 12K	0.2	-45.0
	5	HS Carbon 12K	0.2	-45.0
	6	HS Carbon 12K	0.2	45.0
	7	HS Carbon 12K	0.2	90.0
	8	HS Carbon 12K	0.2	0.0



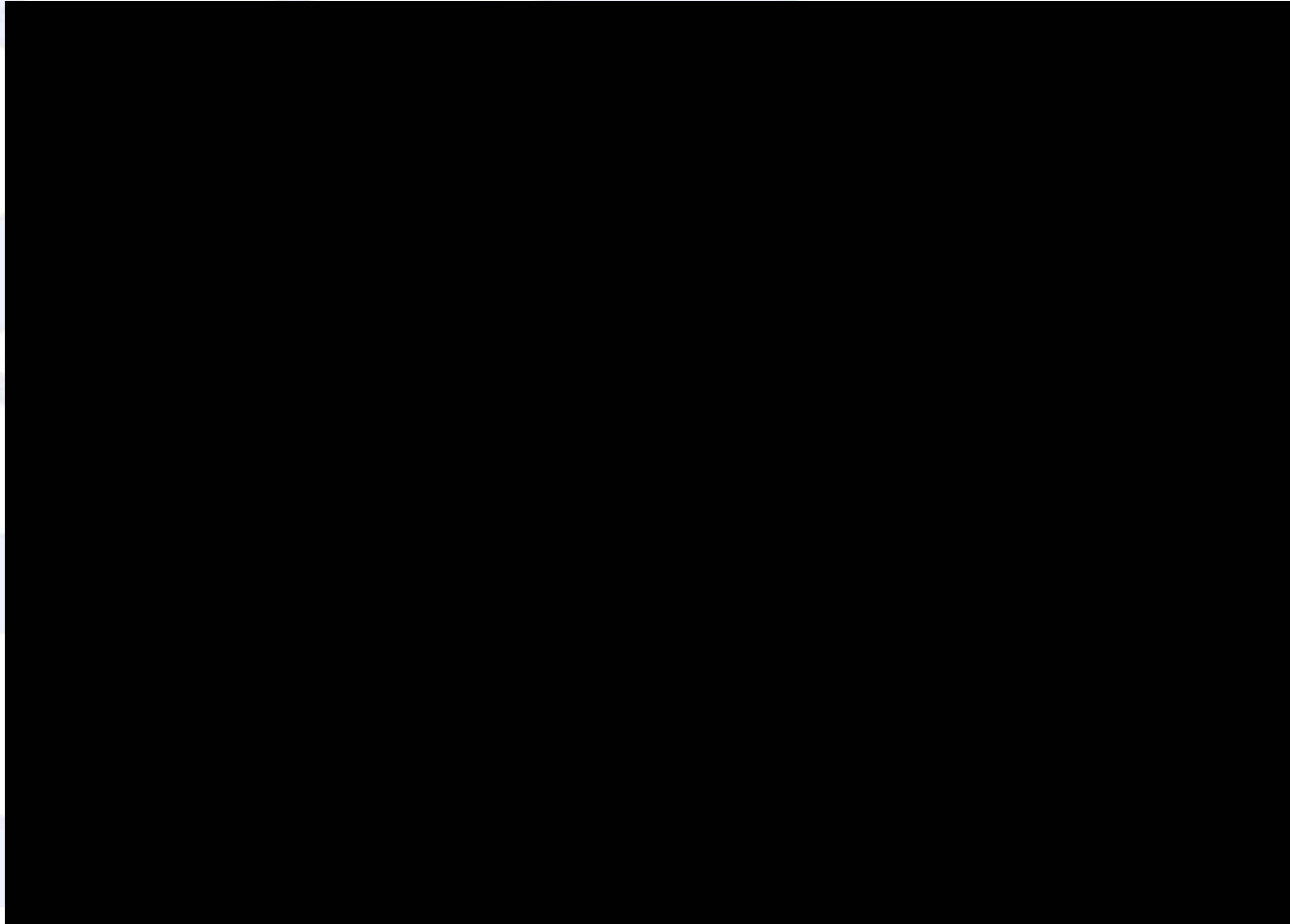
Mechanical Optimisation

Contour Plot
Element Stresses (2D & 3D)(vonMises)
Analysis system
-9.793E+01
-7.807E+01
-6.831E+01
-5.856E+01
-4.880E+01
-3.904E+01
-2.928E+01
-1.952E+01
-9.759E+00
-1.240E-15
No result
Max = 8.783E+01
3D 16605
Min = 1.240E-15
3D 14762

Result : C:/Documents and Settings/stefucan/Desktop/opt a

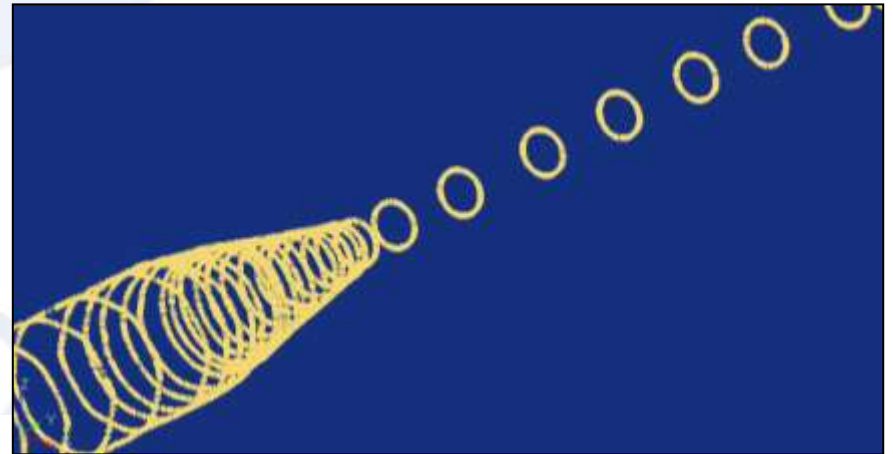
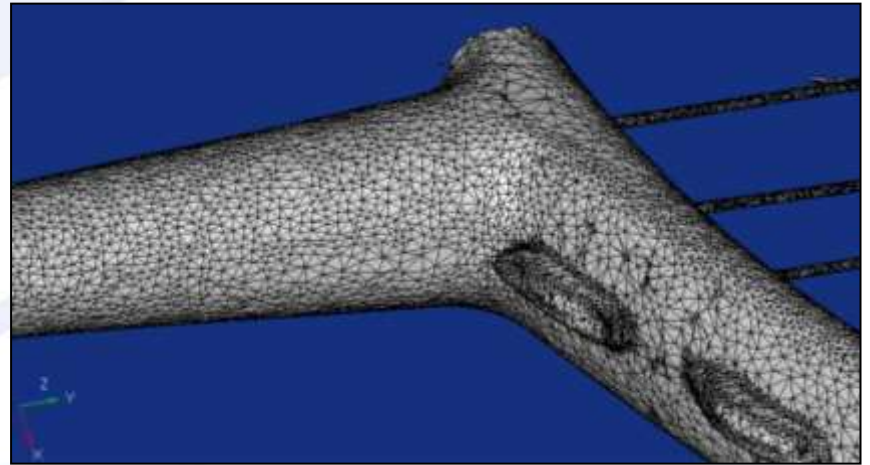


Mechanical Optimisation

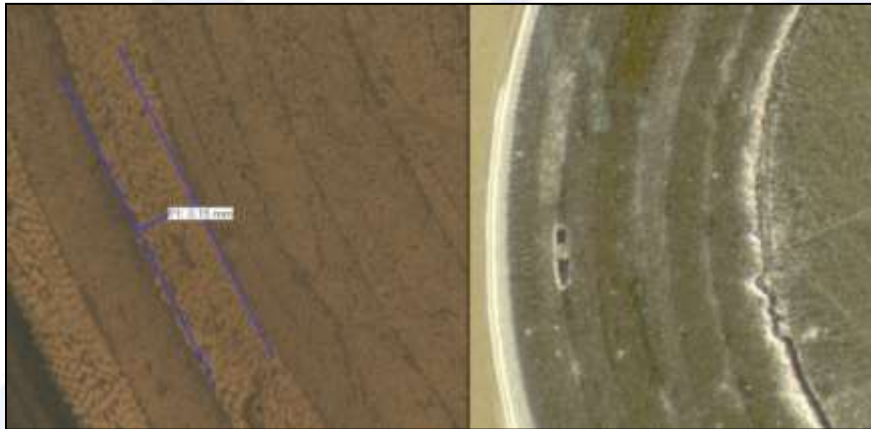












Composite Study

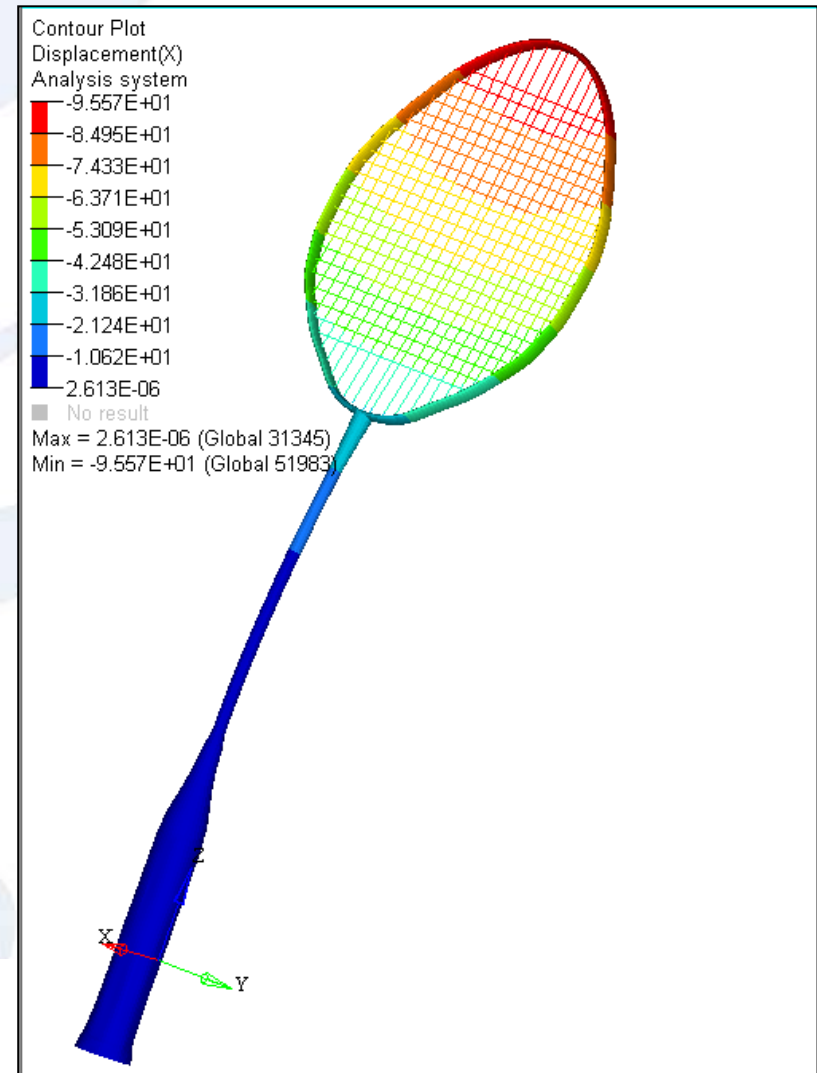
- Reverse engineering



Composite Study

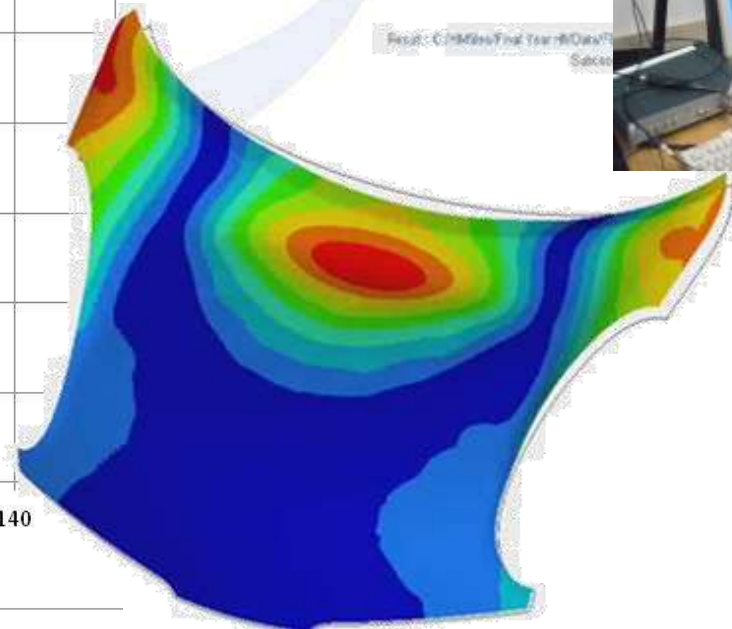
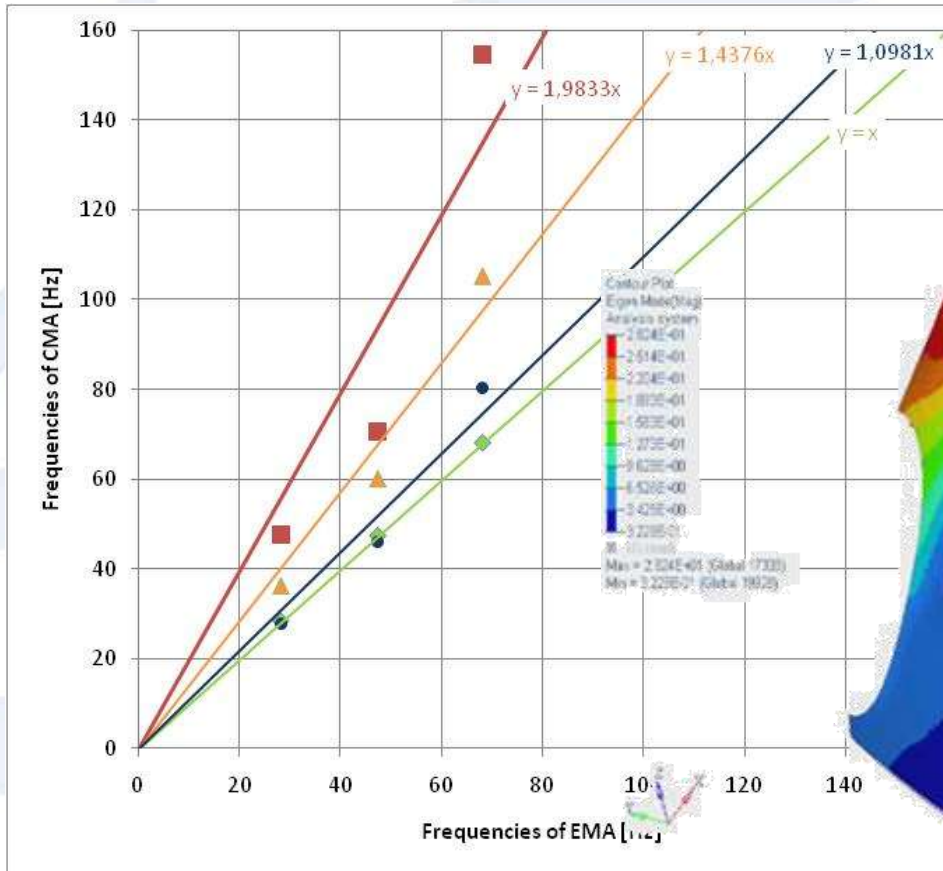


		3	CFRP	0.17	45.0
		4	CFRP	0.17	0.0
		5	CFRP	0.17	45.0
		6	CFRP	0.17	0.0
		7	CFRP	0.17	45.0



Normal Modes Analysis

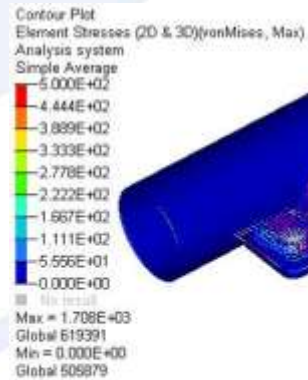
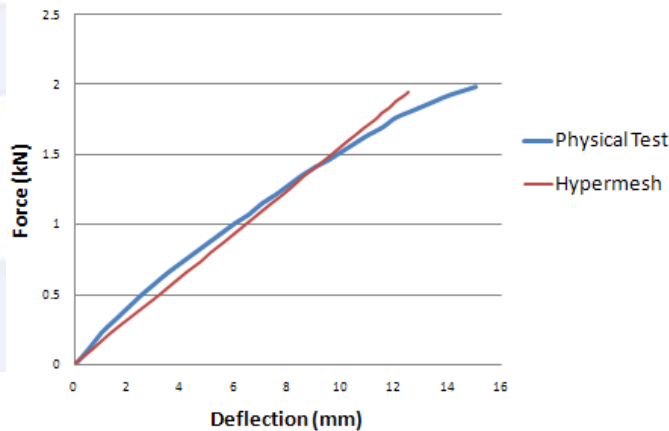
- HyperStudy used to tune glue stiffness



Roll Cage Analysis



Roll Cage Correlation Test



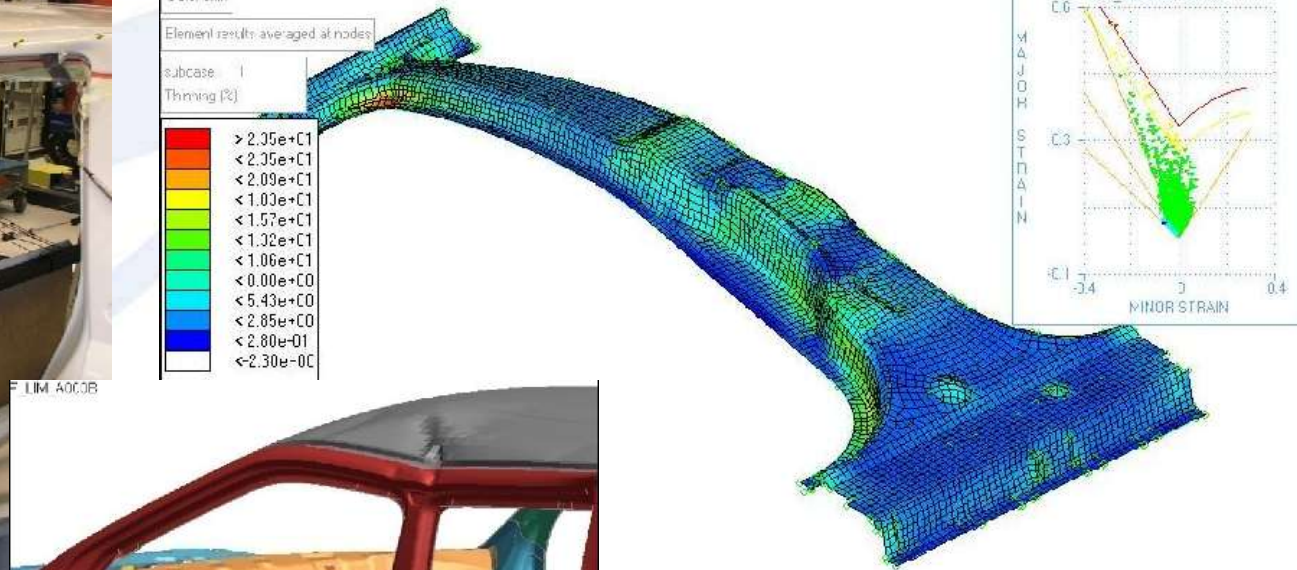
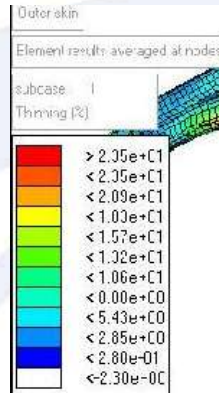
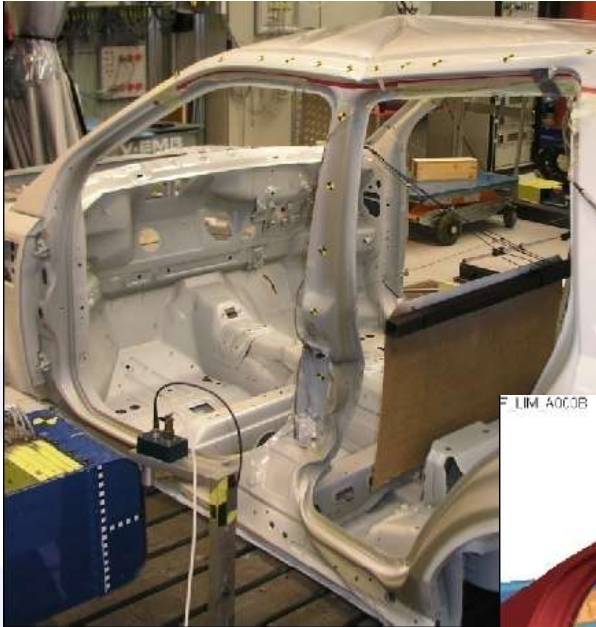
MIRA Roll Cage Bracket -
Subcase 1 (Bending) : Static Analysis
Frame 1



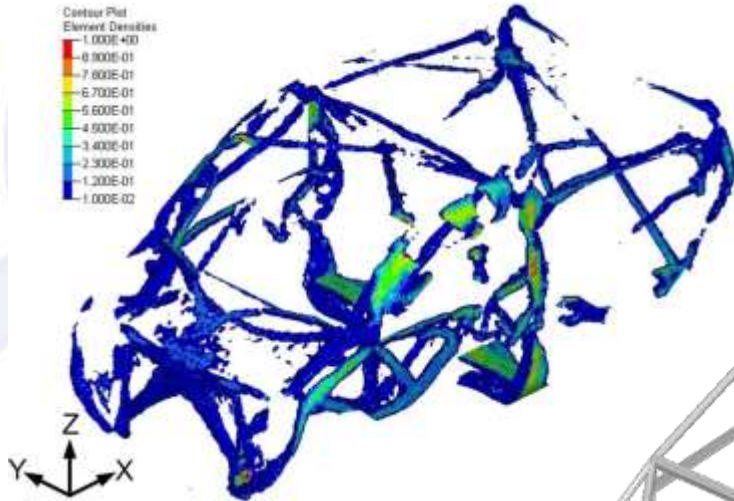
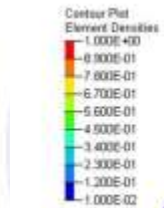
MIRA Roll Cage Bracket -
Subcase 1 (Bending) : Static Analysis
Frame 1



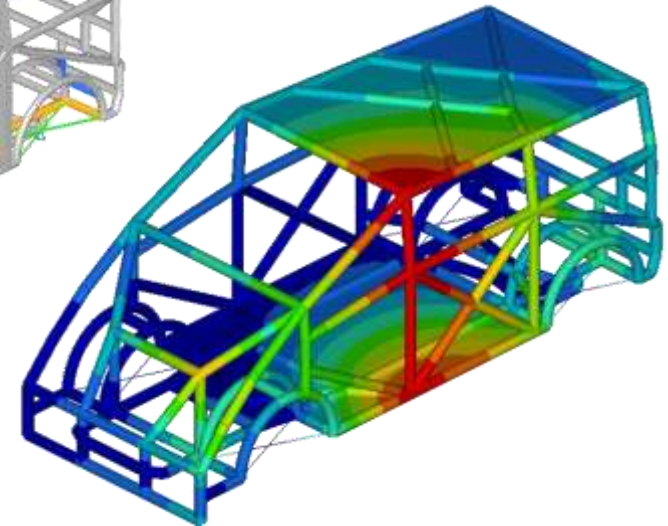
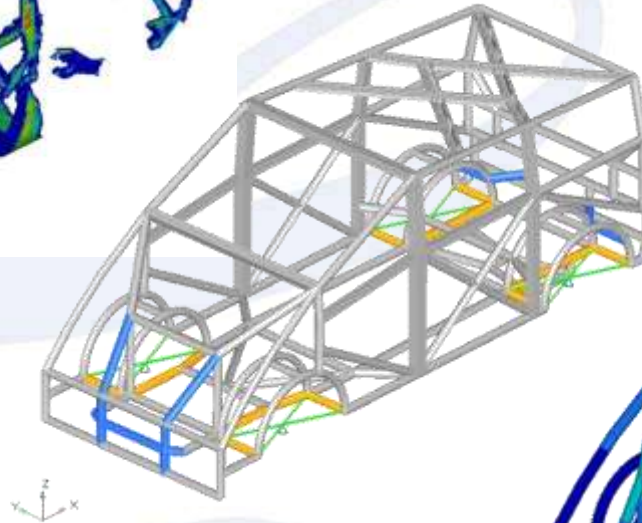
HyperForm and LS-Dyna



LCVT Research



Full vehicle BIW
optimisation



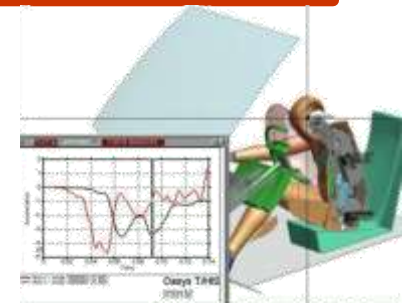
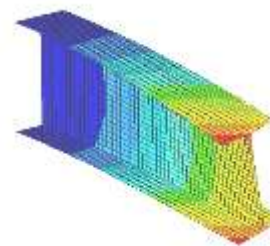
Early years...



Engaging with FEA



Analytical Modelling



Acknowledgements

- For their for their continuous commitment and student support
 - Jesper Christensen
 - Nick Ravenhall
 - Raoul Popescu
- For their continuous support and making the implementation of HyperWorks a success at Coventry University
 - Daniel Nieto
 - Baljesh Mehmi

Thank you for your attention