

SOTA panel session, WCSMO11, June 11 2015



Design applications: success stories and emerging opportunities

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The overview is mainly based on the 343 abstracts and 167 associated conference papers.

NB: Apologize in advance for any omission of a success story – it has not been ignored on purpose 😊



Optimization papers including “standard benchmark examples” (with main focus on development of methods) 1/2

More than 220 presentations in this category, and most are related to structural optimization (size, shape or topology) with focus on mechanical performance.

Some sub categories with other physics or specialized areas:

- Heat transfer / fluid flow: 13
- Wave propagation (ICT, Energy, cloaking devices, ...)
 - Acoustics/phononics: 12
 - Photonics: 9
- Electromagnetics: 7
- Piezo-electricity / energy harvesting: 6
- Electronics: 3
- Design of actuators and sensors (not included above): 6
- Fluid-structure interaction: 4
- Other multiphysics interaction problems: 3

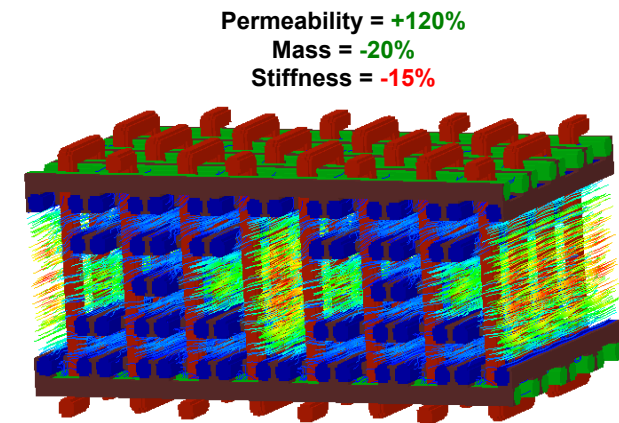


Optimization papers including “standard benchmark examples” (with main focus on development of methods) 2/2

More than 220 presentations in this category, and most are related to structural optimization (size, shape or topology) with focus on mechanical performance.

Some sub categories with other physics or specialized areas:

- Design of microstructure: 16
- Multi-scale: 14
- Composites: 15
- Design for Additive Manufacturing: 9
- Other manufacturing constraints: 9
- Stress constraints: 12
- Fatigue constraints: 5
- Seismic response control: 6
- Robotics: 4
- Machine elements: 3



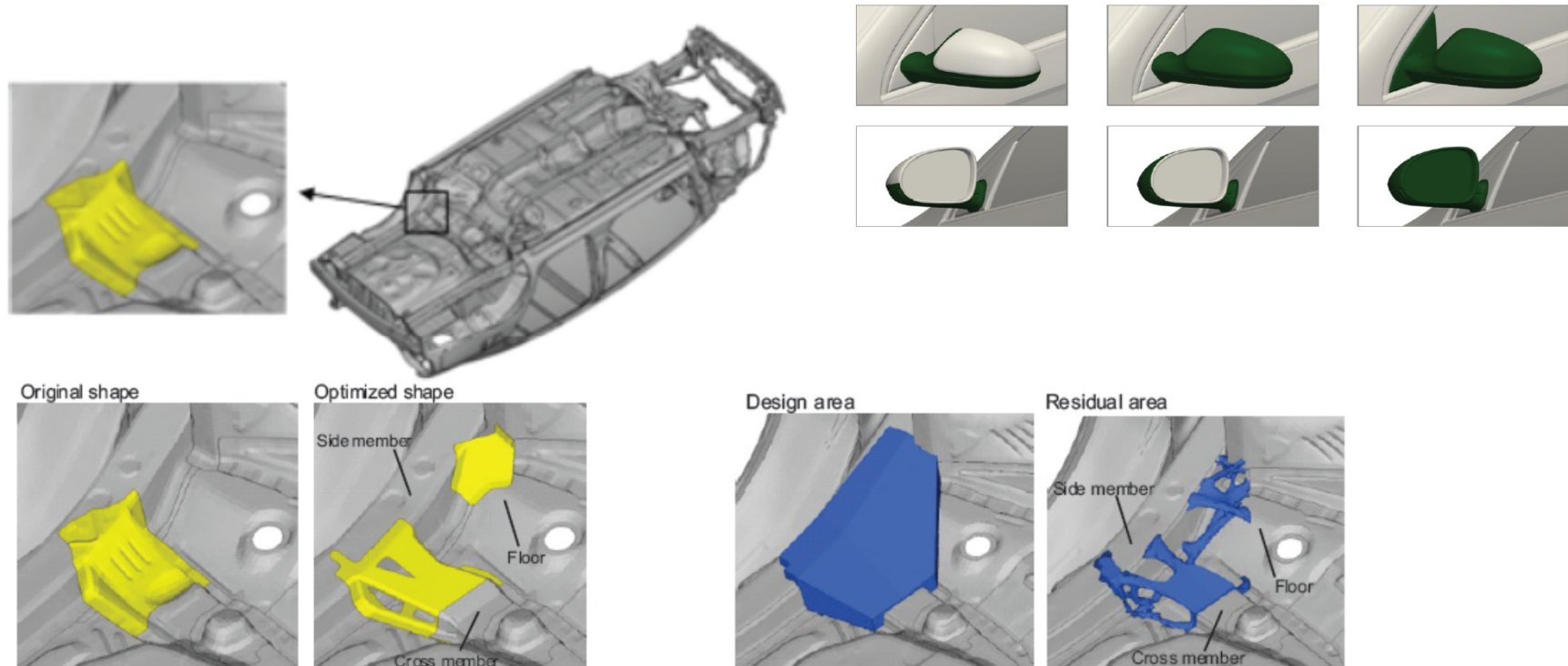
(Paper ID: 1353)



Success stories within transport – automotive 1/2

24 presentations with the following subtopics:

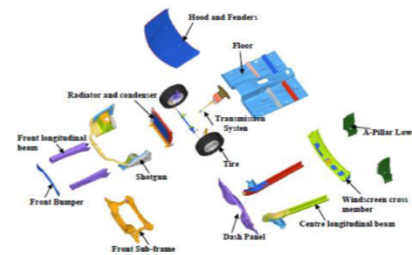
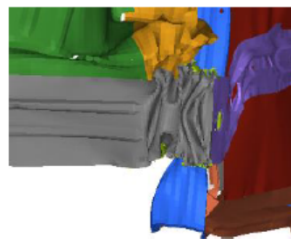
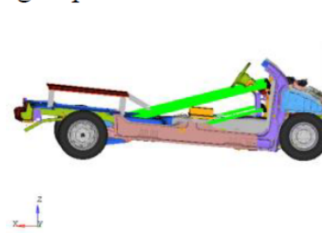
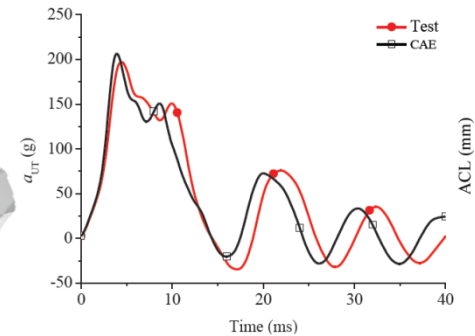
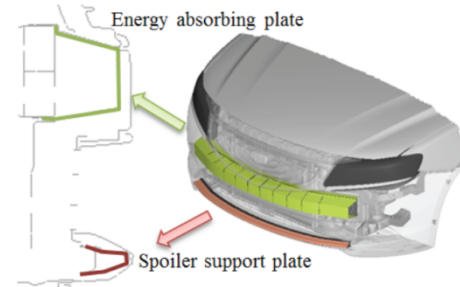
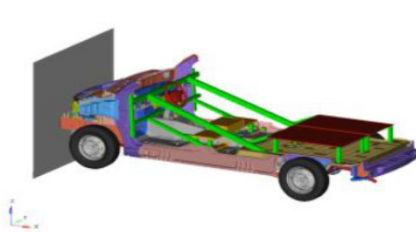
- Vehicle design (paper ID: 1007, 1059, 1196, 1203, 1365, 1440)
- Automotive components (1037, 1074, 1146, 1149, 1178, 1191, 1215, 1258, 1356, 1357, 1398, 1401)



Success stories within transport – automotive 2/2

24 presentations with the following subtopics:

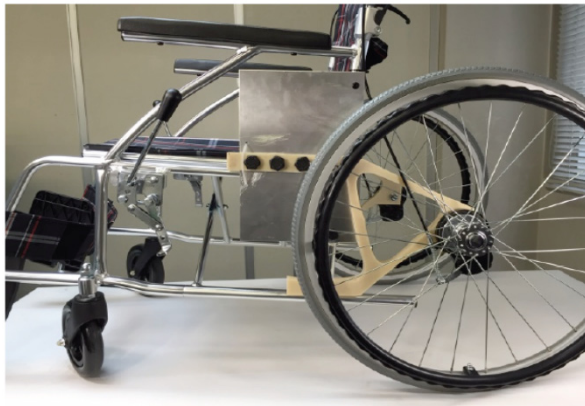
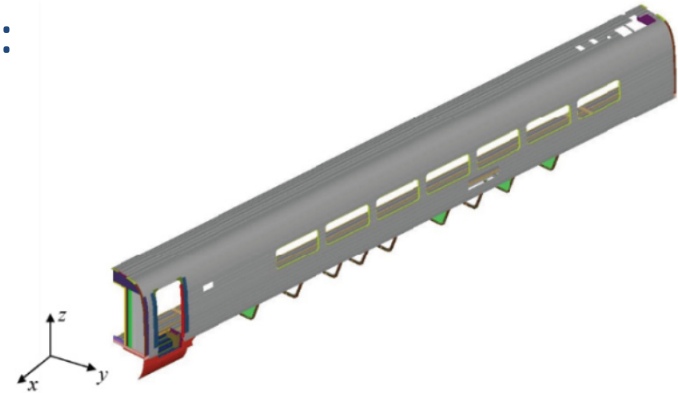
- Crash optimization (1033, 1036, 1049, 1114)
- Occupant safety / airbags (1134)
- Pedestrian considerations (1455)



Success stories within transport – others

3 presentations with the following subtopics:

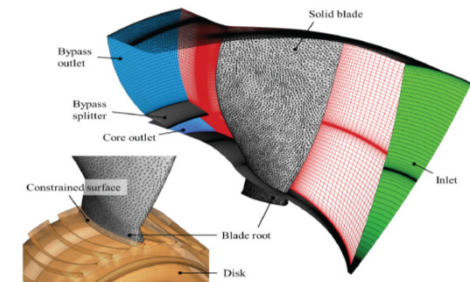
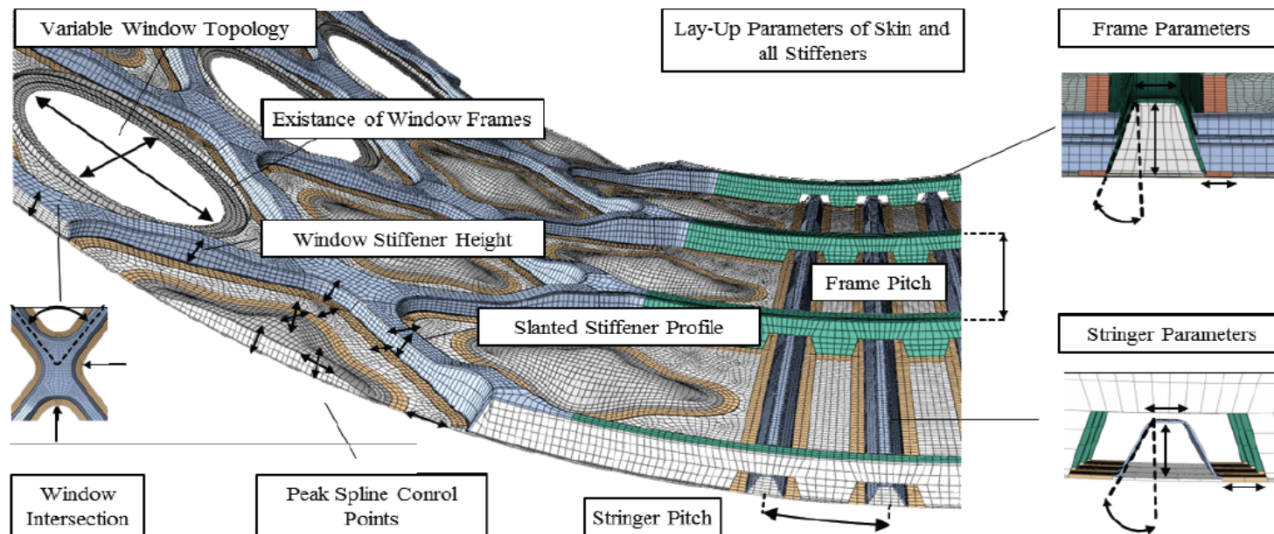
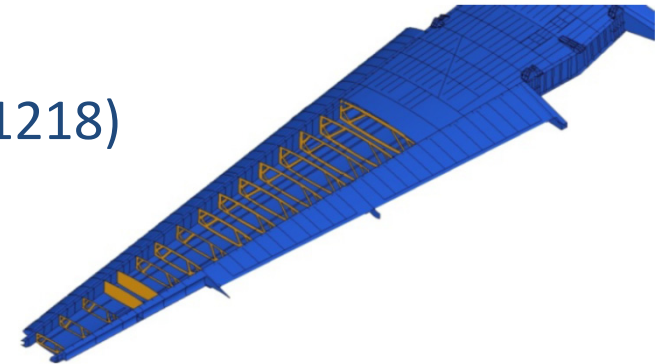
- Trains (1037)
- Ships (1129)
- Wheelchair – comfort (1451)



Success stories within aircraft

14 presentations with the following subtopics:

- Aircraft wings (1013, 1023, 1106, 1160, 1184, 1218)
- Aircraft design (1052, 1099, 1164)
- Aircraft parts (1087, 1238, 1310, 1421)
- Rocket design - MDO (1085)



Papers with recommendations for automotive and aerospace

3 presentations with recommendations for the further development of optimization within automotive and aerospace areas:

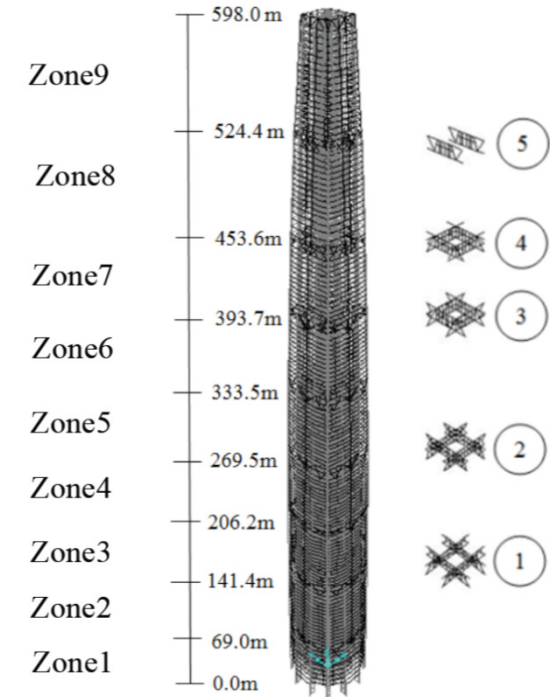
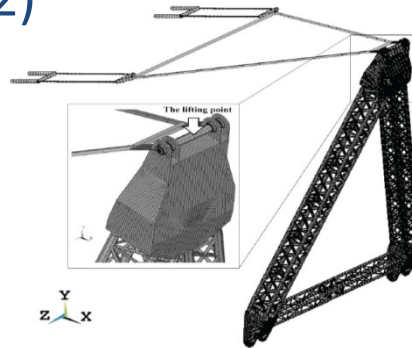
- 1322 - Future challenges for topology optimization for the usage in automotive lightweight design technologies (Volkswagen AG, Technical University of Braunschweig, and University of Wuppertal).
- 1435 - Common automotive and aerospace requirements for commercial structural optimization software (Boeing and BMW).
- 1436 - Multidisciplinary optimization and integration requirements for large-scale automotive and aerospace design work (Boeing and BMW).



Success stories within other structural optimization areas

5 presentations within very large structures with the following subtopics:

- Super tall buildings (1080, 1081, 1082, 1083)
- Giant boom cranes (1402)



1 paper on TV packaging optimization (1194)

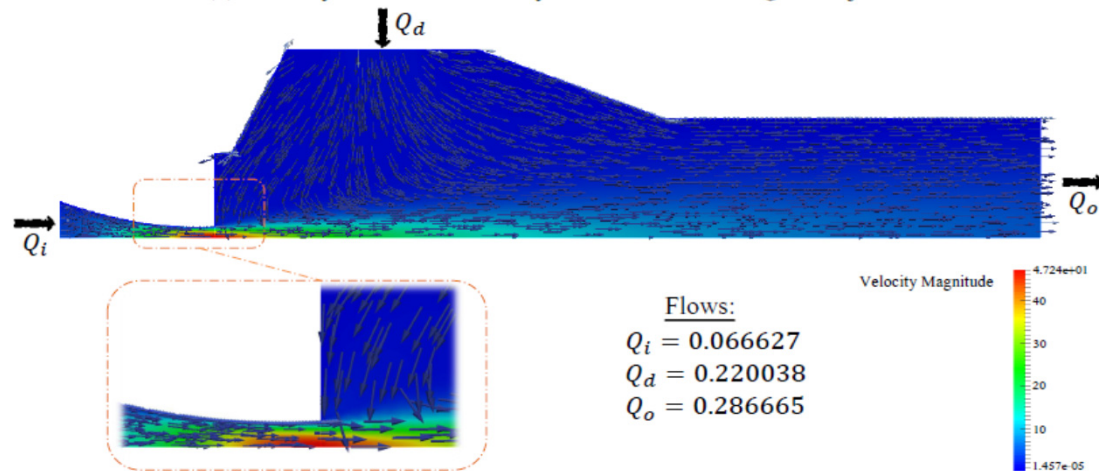


Success stories within heat transfer and fluid flow

- Topology optimisation of passive coolers for LED lamps (1264)



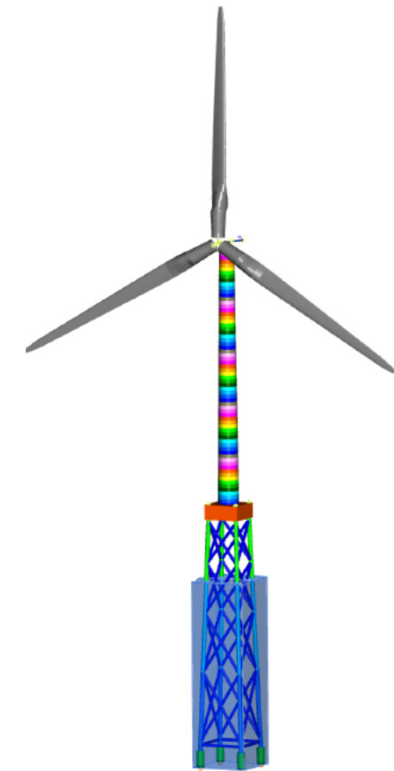
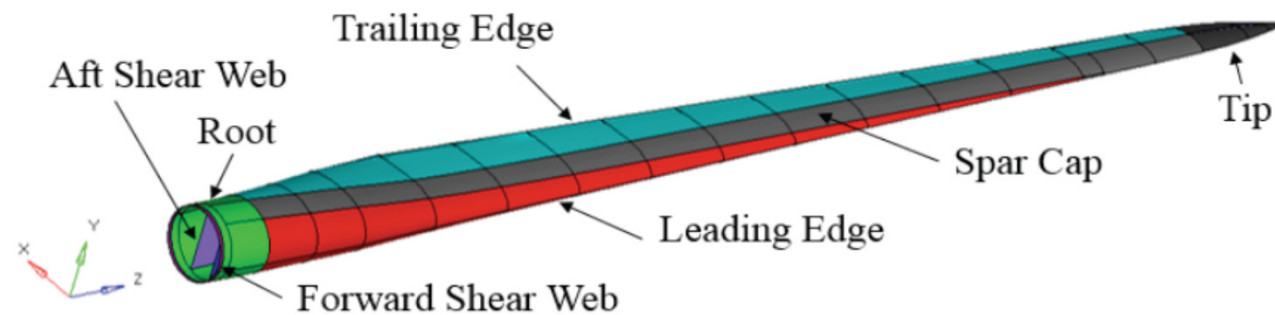
- Optimization of the gas injector shape (1352)



Success stories within renewable energy

8 presentations within wind energy with the following subtopics:

- RBDO of blades (1200)
- Bearings (1287)
- Jacket structures (1326, 1427)
- Wind farm layout design (1330, 1347, 1389)
- Wind turbine component design (1390)



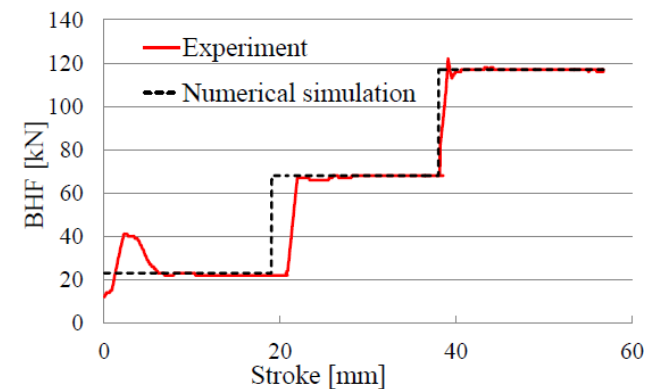
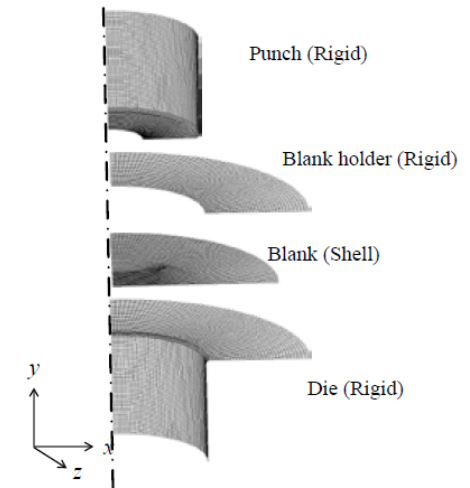
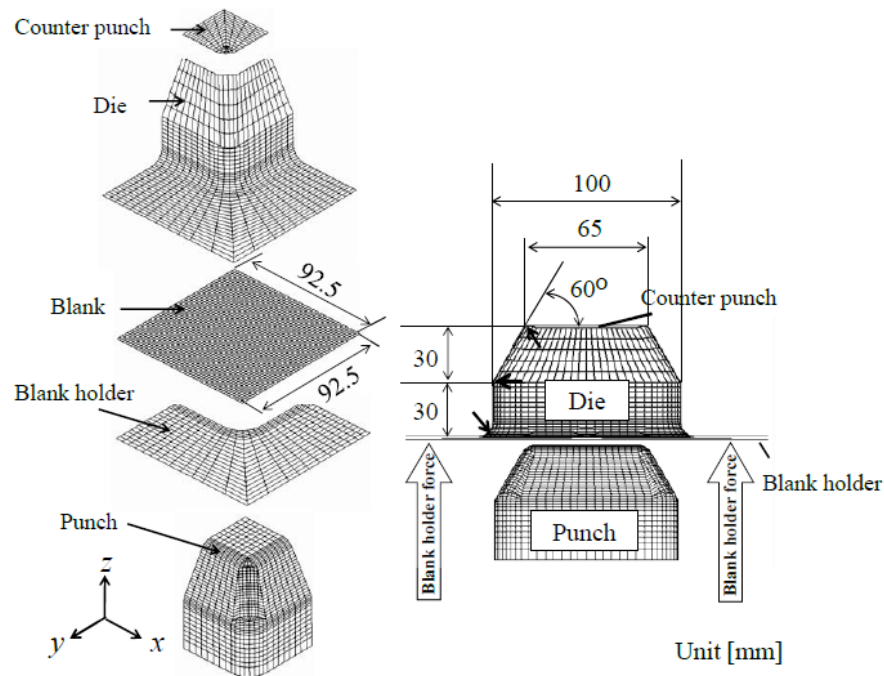
3 papers within solar thermal power (1213, 1331, 1424)



Success stories within process optimization

7 presentations within process optimization with the following subtopics:

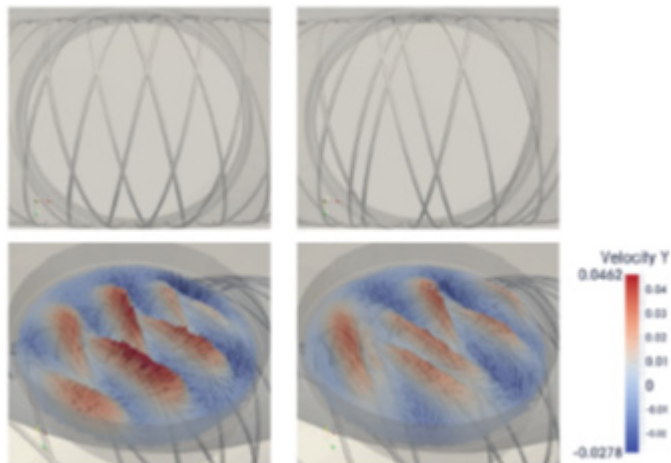
- Deep drawing (1102, 1375, 1391, 1409)
- Cold rolling (1075)
- Three-roll skew rolling (1122)
- Injection moulding (1453)



Success stories within health

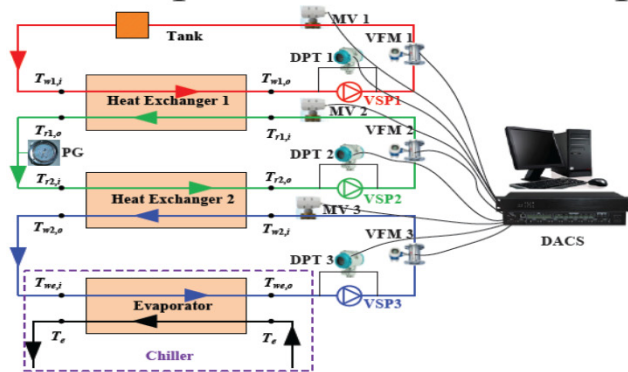
7 presentations with the following subtopics:

- Orthopedic prosthetic devices (1016)
- Dentures (1028)
- Stents (1110, 1456)
- Fractal vasculature (1138)
- Bone tissue engineering (1459)
- Drug molecular design (1452)

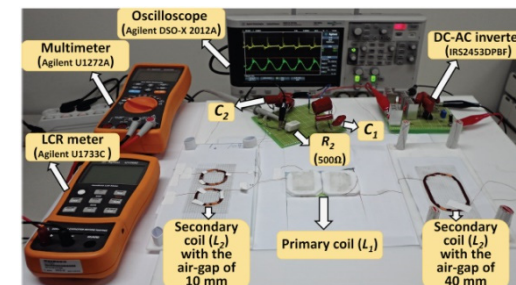
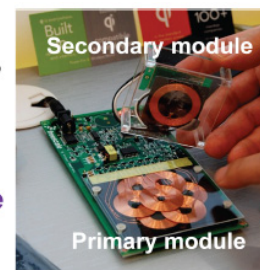
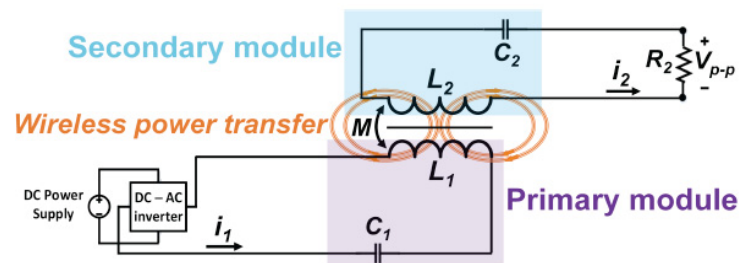


Success stories within control and electromagnetics

- Optimal control strategies for valves in heat exchanger networks (1034)



- Electromagnetic levitation coil design (1307)
- Wireless power transfer (1097)



Observations and emerging opportunities

- Aircraft and automotive are major targets for structural optimization.
- Very many presentations of topology optimization methods while quite few on shape optimization methods.
Very few presentations (5 papers?) on shape optimization based on IGA (isogeometric analysis). Hot topic on computational mechanics conferences. Should be emerging field.
- Very little MDO (less than 8 papers with focus on methods for MDO?). Is that only because the 16th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference is held very close to WCSMO-11 (on 22–26 June 2015)?
- Much fewer presentations of optimization algorithms (mathematical programming) than seen on previous WCSMO congresses (6 papers?).



Observations and emerging opportunities

- Mature level of handling multi-physics problems – very many opportunities in these directions for solving real life problems.
- A slight increase in other physics than structural problems compared to WCSMO-10 – very many opportunities.
- Additive manufacturing: mentioned in many presentations but not really exploited yet. Huge potential!
- Integration of manufacturing rules/simulations in the design optimization loop. This could highly increase the impact of design optimization for real life applications.



Observations and emerging opportunities

- Design of engineered materials (microstructure design / single- and multi-functional materials / metamaterials / multi-scale methods): again: great potential in these areas, especially if manufacturing is taken into account.
- ICT (Information and Communication Technologies): more presentations here than at WCSSMO-10 – many opportunities.
- Health: many opportunities.
- In general: very many emerging opportunities for our society 😊



Thanks to the Local Organizers of WCSMO-11 for a well-organized and scientifically splendid congress together with a great social programme and atmosphere 😊

