NAFEMS

The international Engineering Analysis Community

Conference Proceedings

NAFEMS NORDIC CONFERENCE 2014

Göteborg, Sweden
13-14 May

Engineering Simulation:
Best Practices, New Developments, Future Trends

AGENDA – TUESDAY, 13 MAY 2014

Time	Room 1	Room 2
	SESSION 1 – KEYNOTE / APPLICATIONS	
10:30	**Welcome and NAFEMS Introduction** T. Morris (NAFEMS)	
10:40	**Keynote-Presentation: Crash CAE with Failure Prediction at Volvo Cars Safety Centre** J. Jergeus (Volvo Car Corporation)	
11:20	**Reducing Delamination Risk for SnapLED Package Designs** S. Noijen (Philips Research); C. Soong, S. Tan (Philips Lumileds)	
12:10	**Lunch**	
	Room 1	Room 2
	SESSION 2 – APPLICATIONS	**SESSION 3 – TRAINING**
13:20	**CAE Pre- and Postprocessing for Offshore Structures Design** S. Chatzimoysiadis, G. Korbetis, D. Georgoulas (BETA CAE Systems)	**E-learning Short Course: Fatigue & Fracture Mechanics in FE Analysis** T. Abbey (NAFEMS training manager)
13:50	**Flexible Hoses Design: From Physical to Virtual Prototype** P. Andry, J. Coloos (LMS, A Siemens Business)	cont´d
14:20	**Discrete Element Modeling of Granular Materials** D. Aspenberg, A. Bernhardsson, D. Hilding (DYNAmore Nordic)	cont´d
14:50	**Squeak & Rattle Simulation at Volvo Car Corporation using the E-LINE Method** P. Sabiniarz (AF Consult); J. Weber (Volvo Cars)	cont´d
15:20	Refreshment break	
	Room 1	Room 2
	SESSION 4 – CFD	**SESSION 5 – PROCESSES**
16:00	**CFD-Simulations in Transmissions and Gearboxes** F. Jareman (AF Consult)	**Simulation of Residual Deformation from a Forming, Welding and Heat Treatment Process in Alloy718** E. Odenberger (Industrial Development Center); M. Schill (DYNAmore Nordic)
16:30	**Methods for Performing Fluid Structural Interaction Simulations on Real Industry Cases** T. Berg (Ansys Sweden)	**Simulation of Asymmetric Electric Resistance Forge Welding Processes** B. Hannafious, T. Oosterkamp (Polytec)
17:00	**Multiphysics Simulations of Light Water Reactors using a CFD Approach** K. Jareteg (University Gothenburg)	**Fatigue Analysis of Weld Seams Considering Geometrical Manufacturing Deviations** G. Spindelberger, H. Dannbauer, K. Hofwimmer, C. Gaier (ECS Engineering Center Steyr)
17:30	**External Aerodynamics CFD Simulations of the DrivAero Vehicle Model** S. Chatzimoysiadis, V. Skaperdas, A. Iordanidis (BETA CAE Systems)	**Simulation Software-Driven Developments of Design, Engineering, Manufacturing, and Quality Control Processes within Integrated CAD/CAM/CAE/CAQ Systems** S. Zietarski, S. Kachel, A. Kozakiewicz (Military University of Technology (WAT))
18:00	**Come together in the exhibition area**	

Subject to alteration.

	Room 1	Room 2
	SESSION 6 – STRUCTURE/COUPLING	**SESSION 7 – TRAINING**
08:30	**Usefool Tools in the Design Process of Rotor-Bearing Systems** N. Wagner, R. Helfrich (Intes GmbH)	**E-learning Short Course: Non-Linear FE Analysis** T. Abbey (NAFEMS training manager)
09:00	**A Co-Simulation Approach of a Sliding Door Slam Test** A. Paraschoudis, S. Patil (BETA CAE Systems)	cont´d
09:30	**Vacuum Drying of Umbilical Cable: Thermal Simulation of Electrical Heating and Analysis of Electromagnetic Effects** B. Hannafious, L. Vasilyev (Polytec)	cont´d
10:00	Refreshment break	
	Room 1	Room 2
	SESSION 8 – MATERIALS/METHODS	**SESSION 9 – TRAINING**
10:30	**Simulation Data Management – The Materials Perspective** D. Williams, A. Fairfull (Granta Design)	**E-learning Short Course: Dynamic FE Analysis** T. Abbey (NAFEMS training manager)
11:00	**A Platform Oriented Approach to Material Modeling as Enabler for Integrative Simulations** Z. El Hachemi, G. Boisot, J. Seyfarth, R. Assaker (e-Xstream engineering)	cont´d
11:30	**Accelerate Virtual Testing Procedures by Single Core Modeling** P. Ullrich, W. Hal (ESI Group)	cont´d
12:00	Lunch	
	Room 1	
	SESSION 10 – MODEL EXCHANGE/ COUPLING	
13:00	**The FMI Open Standard for Model Exchange and CAE Tool Interoperability** M. Gäfvert (Modelon)	
13:30	**Performing Coupled Electromagnetic and Fluid Simulations for Thermal Assessment of Electrical Motors** T. Virdung (Ansys Sweden)	
14:00	**Noise Prediction for Electrical Motors by Coupling Electromagnetic and Vibroacoustic Simulation Tools** K. De Langhe, P. Segaert (LMS, A Siemens Business)	
14:30	**Coupled Field Analyses for Extremely High Loaded Thermal Sensor Characterization at Design Development Stage** K. Kamberov, G. Todorov, B. Romanov, Y. Sofronov (Technical University Sofia)	
15:00	**Farewell**	
15:10	**End**	

Subject to alteration.

Coupled field analyses for extremely high loaded thermal sensor characterization at design development stage

Prof. Dr. Eng. G. Todorov, Dr.Eng. K. Kamberov, Eng. B. Romanov, Eng. Y. Sofronov

Technical University – Sofia, Faculty of Industrial Engineering, Laboratory "CAD/CAM/CAE in Industry"

1 Introduction

The focus of this study is set on an extremely loaded temperature sensor. One area where temperature sensors find particular usefulness is in the area of exhaust gas environments. Various applications require measurement of temperature of gas or mixture of gases at elevated temperatures. One such application involves automotive or combustion applications in which a need exists for measuring the exhaust gas temperature for emission control using Selective catalytic reduction (SCR) and Exhaust Gas Recirculation (EGR) based emission after treatment systems. The sensor should function in a harsh and corrosive automotive exhaust gas environment containing, for example, soot particles, SOx, moisture, diesel, NH3, NOx, HC, CO, CO2 etc. [2, 3] Examined sensor is generally suitable for monitoring of moderately supercharged petrol engines, designed for applications that almost never exceed 850°C.

Fig. 1
Examined temperature sensor and used approach

Design development requires information concerning sensor behaviour under thermal loads, especially in two directions – response time and structural stresses that are results of thermal expansion of the structure. This is achievable through virtual prototyping, using numerical techniques. [1,3]

2 Problematics and approach. Experimental data

Two major problems are examined through this research:

- How protective cap design influences sensor response dynamics?
    - Thermofluid problem (coupled field analysis)
- How heating characteristics influences structural behavior of sensor components?
    - Structural problem (structural analysis, using data from thermo-CFD analysis)

Problematics require coupled field analysis approach, as for accurate results, it is needed to examine fluid flow, thermal parameters and force-deflection behaviour. Thermo-fluid simulation is needed to be performed to evaluate influence of protective cover over sensor reponse. The results are also to be used for more precise loads definition for structural analysis. All simulations are to be compared to measured by certain experiments data.

General schematics of used approach is shown on figure 1 above. Experimental measurements for fluid flow parameters and sensor response temperatures will be used as reference to adjust built

thermo-CFD analysis. This coupled field simulation will be performed over design variants with protective cover and without. Transient analyses results are to be compared and detailed fluid flow and thermal parameters are to be examined to find relations between protective cover design and sensor response time.
Two sets of experiments are performed – with and without protective cover. Representatives of the performed measurements are shown on figure 2 below.

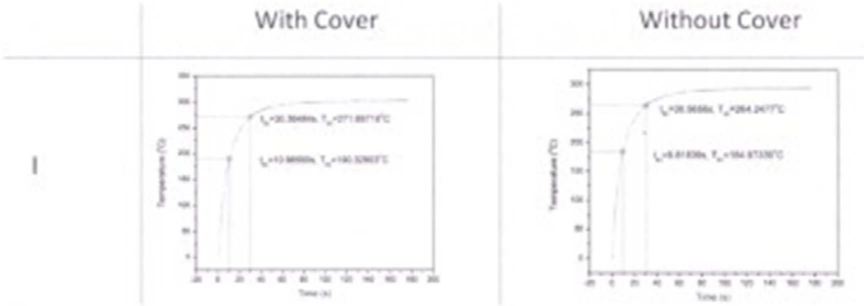
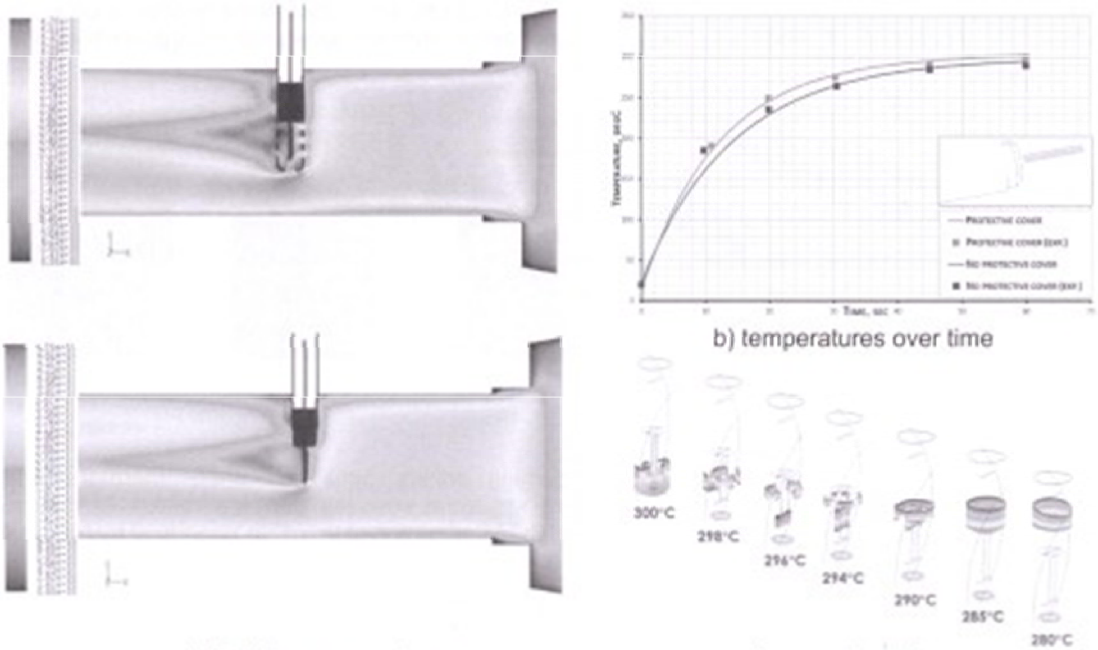


Fig. 2
Experimental data

3 Thermo-CFD simulations

Transient thermo-CFD analyses are performed as to obtain sensor behaviour when is subjected to heated fluid flow. Results for variant with protective cover are compared to these without protective cover – as fluid flow parameters and as temperature response over time (figure 3). Temperature distribution by zones are determined to be used as input data for subsequent structural analysis (figure 3 c)).



a) fluid flow parameters c) temperatures by zones

Fig. 3
Coupled thermo-CFD analyses results

4 Structural analysis

Last step is to performed structural (steady state) analyses under thermal loads - determined layered temperature fields. Major searched results are sensor deflections (character of loading is explored mainly) and equivalent stresses (strength check against materials limits). This allows to evaluate mechanical behaviour of examined variants in detail as well and to obtain a complex general view of problematics. Critical zones are marked for further research and optimisation. Sample results – as overall deformation field and stresses – are shown on figure 4.

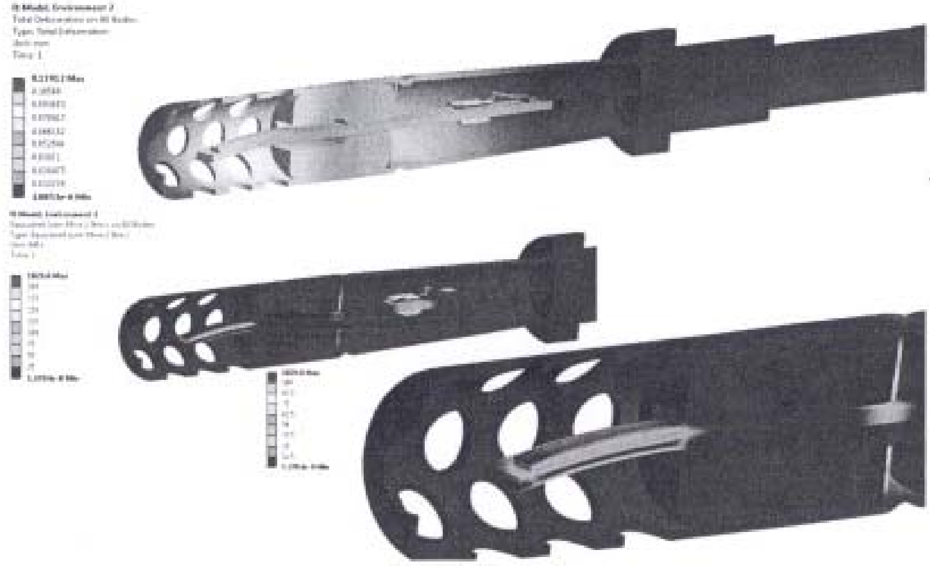


Fig. 4
Structural analyses results

5 Conclusions

Turbulent hot air flow is modeled in detail as to track design changes impact over sensor response times, caused by protective cover design. Performed simulations are verified over physical prototypes of the examined design variants. Obtained temperature distribution field and computed convection parameters are used for subsequent structural analysis to evaluate design force-deflection behavior. Demonstrated engineering analyses process is a good base for future practice of design evaluation at earliest possible design stage using virtual prototypes.

6 References

[1] Ikai Y., Eto T., Hanawa S., Murasawa N.: "Development of a Virtual Exhaust Gas Temperature Sensor based on the Simple Physics-Based Models", JSAE Annual Congress (Autumn), 2013

[2] Kee R., Hung P., Fleck B., Irwin G. et al., "Fast Response Exhaust Gas Temperature measurement in IC Engines," SAE Technical Paper 2006-01-1319, 2006, doi:10.4271/2006-01-1319

[3] Yoshizawa K., Mori K., Arai K., Iiyama A., "Numerical Analysis of Unsteady Exhaust Gas Flow and Its Application for Lambda Control Improvement," J. Eng. Gas Turbines Power 125(2), pp. 555-562, 2003

Acknoledgements:

This research study is performed by the support of project BG051PO 001-3.3.06-0046 "Young scientists support in the field of virtual engineering and industrial technologies" of Operational Programme "Human Resources Development" 2007 – 2013 framework.