Addressing Eco-Engineering Challenges in Automotive Industry with Modeling & Simulation

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Abstract:

Nowadays, automotive manufacturers are intensively redesigning their products and production processes to fulfill the increasing regulations on emissions and fuel consumption, while also meeting the growing consumer demands on product quality and performance. Overall, the challenge will be to break the transport system's dependency on fossil fuels without sacrificing efficiency and compromising mobility. The ambitious target to reduce greenhouse gas emissions with 60% by 2050 is pursued through a step-wise approach, mandating drastic innovations for all transport modes as well as energy and manufacturing sectors. The Cars Regulation targets to limit the fleet average tailpipe CO_2 emission by all new cars to 130 g/km by 2015 – phased in from 2012 - and to 95 g/km by 2020. Reaching the challenging goals will require 'out of the box' mobility products and solutions, by means of step changes to vehicle designs, yielding new concepts fulfilling the high expectations.

Modelling and Simulation (M&S) methods are an important enabling technology that supports the automotive manufacturers to achieve a green, safe and high-quality products. Worldwide, vehicle manufacturing industry is ever more capitalizing on modelling and simulation as a means to frontload the design challenges into the virtual stage, employing CAE software and embedded systems to fine tune the design of the vehicle, that has become a 'computer on wheels' these days, in which both the mechanical performance and the mechatronics system performance must meet the increasingly challenging performance and customer demands, while reducing the production costs and shortening the time-to-market. By enabling design optimisation in an early stage, efforts spent in expensive and time-consuming physical prototyping iterations are drastically reduced.

The aim of this presentation is to show the impact of the virtual design engineering rationale on the current engine/powertrain and vehicle body structure design process. In the light of the present greenhouse gas discussion, current powertrain development efforts are strongly focused on further increasing the internal combustion engine efficiency, as well as on optimizing the overall energy conversion processes aimed at significantly reducing the fuel consumption and hence CO_2 emission during real vehicle drive cycles. 1D simulation models are instrumental to predict combustion processes and emissions from an early design stage onwards, so that the engine/powertrain performance can be optimized in a balanced manner with the other vehicle subsystems. For the vehicle structure, the focus is on increasingly using lightweight materials to reduce the ecological foot print. Especially in the transportation sector, it will not be sufficient to merely optimize the powertrain efficiency; the substantial deployment of lightweight design materials will be the only viable path to meet the ever more stringent CO_2 emission norms. At present, the massive deployment of lightweight materials in the industrial design process is limited by the lack of predictive modeling tools to simulate the macro-level behavior of lightweight materials structures (such as fiber-reinforced composites and additive manufacturing materials). Siemens PLM aims to close this gap through a strategic R&D ambition to enable predictive CAE modeling methods and software for three functional performance attributes: static strength, dynamic strength (fatigue, crash/crush) and NVH/Acoustics.

Presenter Biography:

Dr. Ir. Stijn Donders was born in Tilburg, The Netherlands, on October 23, 1977. He received his M.Sc. in Applied Physics at the University of Twente, Enschede (Netherlands) in June 2002, and he started working at LMS in Leuven in October that year within an industrial PhD trajectory in the Marie Curie programme under academic supervision of KU Leuven PMA, and completed his dissertation "Computer-Aided Engineering Methodologies for Robust Automotive NVH Design" in February 2008. Since 2013, LMS has become part of Siemens PLM Software as the Simulation & Test Solutions business unit. Stijn Donders currently works at Siemens PLM as Sr. R&D Project Manager, with focus on research project and team management in the fields of lightweight materials engineering, vehicle dynamics and mechatronics, structural analysis and vibro-acoustics. He has experience as project responsible and scientist in charge for various Flemish and European projects, especially in the EC Marie Curie programme. Since 2013, he acts as Secretary in the EARPA task force "Modelling & Simulation" (see http://www.earpa.eu).