MOTOR Newsletter

September 2016

Dear Reader,

On behalf of all consortium members I would like to warmly welcome you to the first edition of the bi-monthly MOTOR Newsletter, in which we will introduce to you our partners, share with you the highlight achievements in the project and inform you about upcoming events. The MOTOR project is generously funded by the European Commission with 4.3€ in the Horizon 2020 research and innovation framework program. It brings together a unique combination of partners from industry and academia in Europe that are committed to developing novel computational technologies to enable fully automated design optimisation of ship propellers, aircraft engines, water turbines, and screw machines. After a year of collaboration we are proud to be able to present the first batch of software modules, which are now being integrated into the workflows of our industrial partners to reduce development times and enable designing outstanding new products. If you are interested in receiving this MOTOR newsletter every third month by electronic mail we kindly ask you to subscribe to it online at our website www.motor-project.eu and share it with interested colleagues from your business networks.

Best regards,
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(Project Coordinator)

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Progress Report

Geometry Modules

The theory and implementation of the mathematical technology of hierarchical splines have been extended, in particular focusing on efficiency and applications to domain parameterization. One of the most important advantages of the hierarchical approach is local adaptivity because it allows to save a lot of computing resources. An efficient implementation of the hierarchical B-splines (HB-splines) and truncated hierarchical B-splines (THB-splines) has been provided in the framework of an open source C++ library Geometry + Simulation Modules (G+SMO). This library and the spline technology implemented therein is extensively used by numerous partners in the MOTOR project and is important for various MOTOR Modules as well as MOTOR Products.

Simulation Modules

The work on simulation modules until now has focussed on the structural mechanics solver module in MOTOR and summarizes the features that are now available for the partners in the G+Smo software framework. Our implementation covers the usual models that are also offered by a typical finite element code. Moreover, since the partner TUDO emphasized the need for a thermo-mechanical coupling as extra feature, we developed a first version of a corresponding multi physics module where the response of the elastic structure on thermal stresses is computed.

Aircraft Engines

A new aircraft engine design methodology using volumetric adaptive splines was successfully developed within the first project year of WP5 in collaboration between the consortium partners JKU and MTU. Based on its implementation and integration into the standard CAE environment of MTU, WP5 is ready for the second project year with the focus on building up the entire shape optimization cycle. Both major improvements, the increased speed (faster by a factor of around 10) and the increased stability (reduced failure rate by a factor of around 3), setting up an ideal basis for fast and flexible design-to-production cycles to tackle the main objective of WP5: A redesigned Turning-Mid-Turbine-Frame (TMTF) with a significant axial shortening while maintaining the overall pressure loss and the influx for the downstream Low-Pressure-Turbine (LPT).

Events

November 24 & 25, 2016
MOTOR General Assembly
Plzen, Czech Republic

Past

April 13 & 14, 2016
MOTOR General Assembly
Waterloo, Belgium

November 24, 2015
G+Smo developer days 2015
Linz, Austria

October 9, 2015
MOTOR Kick-off
Delft, The Netherlands

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Screw Machines

The overall goal of the working package is the optimisation of the rotor lead of screw machines. The approach is sectioned in two major parts: A 0D chamber model simulation and 2D/3D IgA (Isogeometric Analysis) simulation.

During the last months a NURBS-based pre-processor was created that enables the description of the screw rotors as Spline curves and surfaces for the subsequent 2D/3D flow simulation. Furthermore, a new type of chamber model generator was built to ensure a fast generation of chamber models for the thermodynamic 0D simulation.

First results of the chamber model generation and simulation, used for a manual optimisation of the rotor lead of an exemplary refrigeration compressor, were published at the 23rd International Compressor Engineering Conference at Purdue and achieved second place at the student best paper award.

Partner: MARIN

MARIN is the maritime research institute in the Netherlands specialised in model testing and numerical analysis of ships and offshore structures. As an independent research institute MARIN provides advice and design services to a range of clients such as operators, designers and builders of maritime assets. MARIN started out as a model testing facility where ships would be tested prior to the building of the ship. With the uprising of computer applications and the ever ongoing increase of computer power, numerical simulations have gained a prominent place in ship hydrodynamic design and research.

Propeller design optimisation is one of the fields in which MARIN excels. To date the propeller optimization consists mainly of changing the blade outline of the propeller manually. Various numerical tools are available ranging from fast methods for design and time-consuming methods for validation, applied only afterwards. In MOTOR, MARIN will develop a method whereby the demanding validation calculations are integrated into the design process. An optimization strategy will be applied whereby massive number of low-fidelity calculations are coupled to a limited number of high-fidelity calculations using a single geometrical core able to deform the propeller blade automatically.

Partner: CAT

Caterpillar Marine combines all the marketing and service activities for Cat® and MaK™ marine engines within Caterpillar, and recently added monitoring, analytics and prognostic capabilities to the entire vessel through the addition of Cat Marine Asset Intelligence solutions. This along with inclusion of Caterpillar Propulsion, one of the world's leading designers and producers of Controllable Pitch Propellers, enables Caterpillar Marine to move closer towards the strategic vision of serving marine customers as a complete systems solutions provider.

Through Caterpillar Propulsion the result from the MOTOR project will used in the hydrodynamic design of high efficient propulsion components which are exactly matched to the operational profile of the vessel. The specific components developed within MOTOR secures that the latest methodologies and tools are included in this very important part of a full vessel design.

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