



LCM – Center for Symbiotic Mechatronics

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre K2

Drives and their Digital Twins, 2018-2021, multi-firm

VOITH, LCM, AND ELIN MOTOREN DEVELOP ELECTRIC SHIP PROPULSION FOR OCEAN VESSELS

WITH THE EVSP, AN ELECTRIFIED SHIP PROPULSION SYSTEM FOR THE FUTURE OF SHIPPING WAS CREATED. THE METHOD DEVELOPMENT OF THE MOTOR DESIGN WAS CARRIED OUT WITHIN THE FRAMEWORK OF THE K2 CENTER, MOTOR PRODUCTION BY ELIN, SHIP PROPULSION SYSTEM DEVELOPMENT BY VOITH.

For particularly maneuverable ships, Voith has been producing Voith-Schneider-Propellers (VSP) for many years. To meet the challenges of zero-emission shipping, the electrification of the VSP was tackled together with the Linz Center of Mechatronics (LCM) and ELIN Motoren GmbH (ELIN) towards the eVSP.

The Styrian motor manufacturer and K2 partner ELIN was able to optimally take up the simulation and optimization methods for electric drives, which are being developed at the LCM in the COMET K2 center, and thus realize the motor of the eVSP. Particular focus was given to the multi-objective optimization of the e-machine: the parameters of multi-physics simulations and calculations are varied in an automated way to simultaneously optimize for

criteria such as total weight, copper mass, magnetic mass, efficiency, parasitic losses or axial length.

For the design of the 1.85MW drive, numerous new simulation methods were developed by LCM and embedded in LCM's *SyMSpace™* system optimizer. As a result, numerous operating modes such as partial load operating cycles and various faults such as short circuits or overtemperatures can be taken into account. A particular challenge was also presented by the support provided during the realization phase: For the tests of the first motor, a combined motor-generator control had to be implemented by ELIN. In order to interpret the measured values correctly, the entire machine behavior in this atypical operation had

SUCCESS STORY

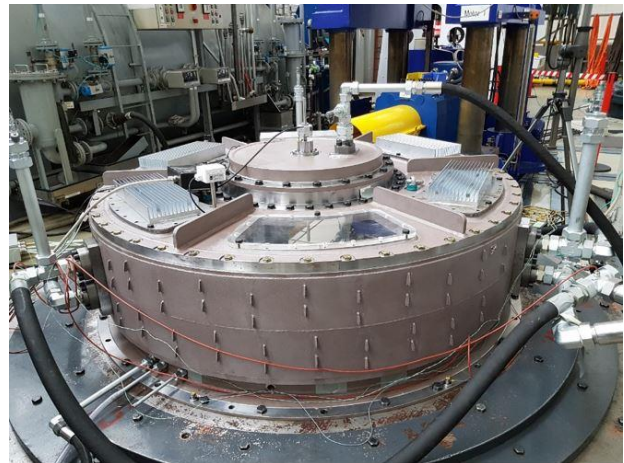
to be simulated by LCM and compared with the nominal operating behavior.

Impact and effects

As of the end of 2021, a commercial implementation of this novel ship propulsion system is well underway - multiple eVSP propulsion systems have already been ordered at Voith for several ships. Several motors are in production at ELIN, in shipyards for installation in the hull, or already built-into the ships. The launch of the first maintenance vessel for offshore wind farms equipped with eVSPs is expected in 2022.

Operational calculations for the use case in these 80m maintenance vessels showed that the huge fuel savings of 370.2 tons of diesel (equivalent to 962.4 tons of CO₂) per year can be expected, even though the electricity to operate the two eVSPs on board is currently provided by diesel generators. In the long term, a hydrogen-electric solution is envisaged. In addition to the goal of making a substantial contribution to meeting the Paris climate agreement in terms of CO₂ emissions, there are other environmentally relevant results:

- Reduction of material input for construction in the eVSP 26 by 17% = 16.3 t per ship,
- Reduction of lubricants in the VSP by 26% (2x200 l per ship) and use of biodegradable lubricants,
- Reduction of noise emission for marine life, increase of comfort for passengers and crew by reduction of sound and vibrations.



Demonstrator E-Maschine des eVSP am Prüfstand bei ELIN, copyright Voith Group

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Project coordination (Story)

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Project partner

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- Voith Group, DE
- LCM, AT

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